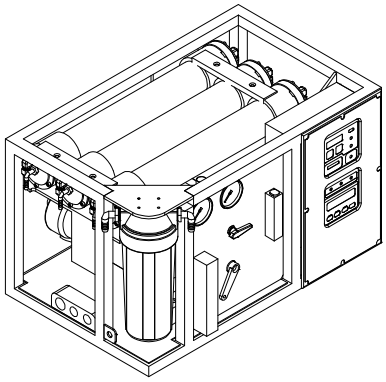
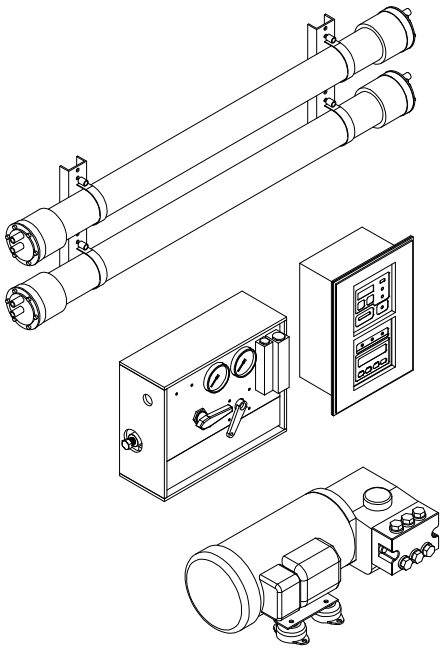
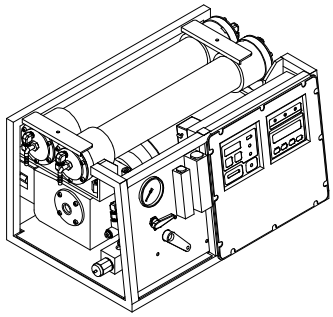
THE SQUIRT/STOWAWAY SERIES



SQUIRT 600



SQUIRT MODULAR 800



STOWAWAY 400

USER GUIDE & REFERENCE MANUAL

Village Marine Tec.

Fresh Water from the Sea

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Village Marine Tec.

Fresh Water from the Sea

SYSTEM START UP LOG

SYSTEM INFORMATION:

MODEL NUMBER: _____

SERIAL NUMBER: _____

DATE OF PURCHASE: _____

PURCHASED FROM: _____

_____

_____

_____

_____

INSTALLATION DATE: _____

START UP PERFORMANCE READINGS:

MEASURE AFTER 3 AND 24 HOURS OR PRESSURIZED TIME IN SIMILAR CONDITIONS

	3 Hours	24 Hours
FEED WATER TEMPERATURE:	_____	_____
FEED WATER SALINITY (IF KNOWN):	_____	_____
BATTERY VOLTAGE:	_____	_____
VOLTAGE AT UNIT:	_____	_____
AVERAGE AMP DRAW (IF KNOWN):	_____	_____
OPERATING PRESSURE:	_____	_____
PRODUCT WATER FLOW:	_____(GPH)	_____(GPH)
REJECT WATER FLOW (IF KNOWN):	_____(GPH)	_____(GPH)
PRODUCT WATER QUALITY (IF KNOWN):	_____(ppm)	_____(ppm)

1.0 INTRODUCTION

SYSTEM DESCRIPTION

Village Marine Tec's (VMT™) the Squirt and the Stowaway series are well-engineered reverse osmosis (RO) systems, designed and built for simple operations and maintenance for the cruising sailor, sport fisherman, or working vessels where space is at a premium. These self-contained AC desalination systems will produce eight to thirty-three gallons per hour (GPH) of freshwater from the sea (gallon production will vary based upon water temperature, salinity, and model of the RO system).

The Squirt and the Stowaway units produce water, meeting or surpassing drinking water guidelines with seawater salt concentrations as high as 32,000 parts per million (ppm).

HOW TO USE YOUR MANUAL

This User Guide & Reference Manual contains important information about the safe operation and maintenance of your Squirt, Squirt Modular, or Stowaway RO unit.

We advise you to please read through the entire User Guide & Reference Manual carefully to ensure you familiarize yourself with the operation of your RO system and follow the recommendations within the manual, to help make your water producing experiences trouble-free and enjoyable.

SAFETY WARNINGS

Throughout this User Guide & Reference Manual you will see many important statements or labels indicated on the product with the following words:

⚠ WARNING **Indicates a strong possibility of severe personal injury or death if warning instructions are ignored.**

⚠ CAUTION **Indicates hazards or unsafe practices of product may cause minor personal injury or may cause property damage.**

NOTE: Text specifies useful information.

INTRODUCTION

1.1 UNPACKING AND HANDLING

The Squirt (SPW), Squirt Modular (MPW), and Stowaway (STW) reverse osmosis units are shipped pre-assembled. There are no special instructions towards unpacking and handling of the watermaker system. Inspect the RO unit to verify it was not damaged in transit. Also, please refer to the plumbing diagrams in **Section 9.0: PLUMBING DIAGRAMS** to verify all components for the watermaker are shipped prior to installation. Be sure to mark and record all hose locations for reference, if disconnection of hoses become necessary.

⚠ CAUTION **DO NOT EXPOSE THE RO UNIT TO FREEZING TEMPERATURES WITHOUT PROPER STEPS TO TREAT THE RO UNIT FOR SUB-FREEZING TEMPERATURES.**

1.2 PERFORMANCE SPECIFICATIONS

Parameter	Specification
Raw water temperature (minimum)	33° F (1°C)
Raw water temperature (nominal)	77° F (25°C)
Raw water temperature (maximum)	113° F (45°C)
Min. raw water inlet pressure	Flooded suction pressure
Max. raw water inlet pressure*	30 psi
Flush water recommended max. pressure	35 psi
Design RO element pressure	800 psi
Max. RO element pressure	1000 psi
Max. feedwater chlorine residual	< 0.1 ppm
Cleaning solution pH range	10-11 (Chemical #1), 2-3 (Chemical #2)
Membrane type	Thin film composite

Table 1.0 - Performance Characteristics

* For inlet pressure greater than recommended limits, install pressure regulator.

NOTE: REGARDING WATER PRODUCTION:
The RO series number (i.e. SPW200, MPW800, or STW400) refers to gallons per day (GPD) production produced with new membranes at design optimum conditions.

To achieve optimum production:
(1) The feed flow must be unrestricted (positive water pressure at the inlet to high pressure pump).
(2) Seawater temperature at 77°F (25°C)
(3) Seawater salinity at 32,000 parts per million (ppm) total dissolved solids (TDS).

Variation of conditions (environmental, temperature, and frequency of use) and normal aging of membranes will decrease RO production. Normal membrane fouling will be partially recovered by chemical cleaning, but 100% recovery should not be expected. Production rates from membrane to membrane can vary ± 15%.

1.3 ENVIROMENTAL REQUIREMENTS

Parameter	Specifications
List (Permanent):	15°
Trim (Fore and Aft):	+ 30°
Pitch:	±10° (6 sec cycle)
Roll:	±30° (12 sec cycle)

Table 1.1 - Nominal Operating Conditions

1.4 CONSUMABLES

Table 1.2 lists the consumables required for any six month operation of the RO unit. Use **ONLY** Village Marine Tec. approved filters and chemicals.

SPW/MPW/STW 200/400/600/800		
Description	**QTY**	**VMT Part No.**
Chemical Cleaning Cartridge Kit #1, #2	$1^{ea}/_{box}$	85-0102
Preservative Cartridge Kit, Chemical #3	2/box	85-0103
Filter, 5 micron, 10 sq-ft.	2/box	33-5010
Filter, Carbon, 10 sq-ft.	1^{ea}	33-0311
Aqua Pro High Pressure Pump Oil	1 qt	85-0050

Table 1.2 – VMT Approved Consumables

1.5 TEST EQUIPMENT

Table 1.3 lists the test equipment for performance verification and maintenance of the RO unit.

Description	VMT Part No.
Meter, Hand Held, 0-5000 ppm	40-5000
Kit, Calibration Singles	40-0017
10X Range Extender for Meter	40-5001
Kit, pH Test, 0-14, 10 Strips Kit	90-0135
Kit, Pump, Crankcase, 3.5 GPM, 3 PLGR	70-6112
Kit, Pump, Fluid End, 3.5 GPM, 3 PLGR	70-6111
Solution, Calibration, 300 ppm	90-1300
Solution, Calibration, 30,000 ppm	90-1301
Economy Mini Water Tester, TDS	99-1990

Table 1.3 – Maintenance Equipment Table

2.0 INSTALLATION

Village Marine Tec. recommends **ALL** Squirt, Squirt Modular, and Stowaway models (as with all other VMT model RO units) be **INSTALLED BELOW** the vessel's waterline, to ensure a flooded suction intake to the unit.

2.1a TO INSTALL THE SQUIRT (SPW) UNIT

Step 1: Village Marine Tec. recommends installing the RO unit in a dry sheltered location at or aft of midship, with drainage underneath (to draw off standing water when performing routine maintenance or service). Also, the RO unit should be installed **BELOW** waterline (Refer to Figure 1). Give consideration to extra space around the RO unit, allowing access for the unit's maintenance (i.e. membrane replacement, oil change, prefilter replacement, or other services).

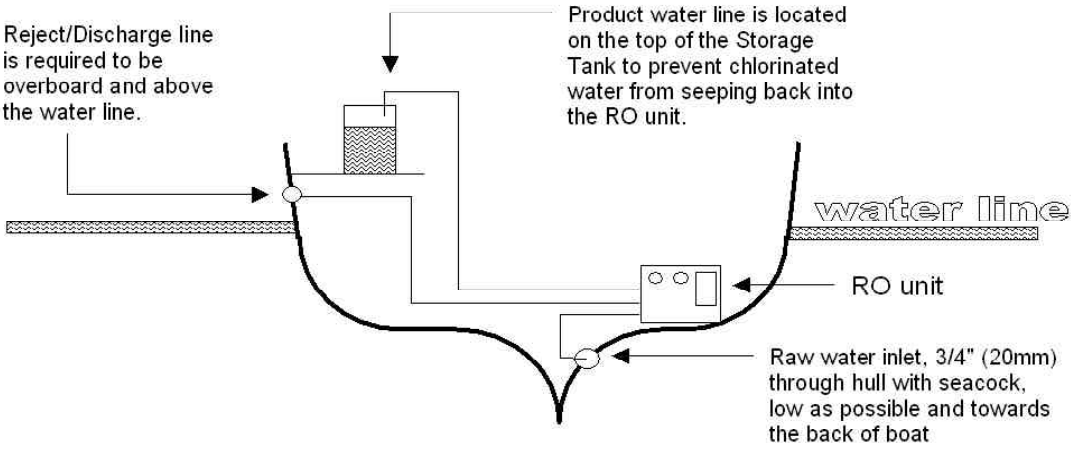

Reject/Discharge line is required to be overboard and above the water line.
Product water line is located on the top of the Storage Tank to prevent chlorinated water from seeping back into the RO unit.
water line
RO unit
Raw water inlet, 3/4" (20mm) through hull with seacock, low as possible and towards the back of boat

Figure 1: Recommended Installation Location - BELOW waterline.

If the **SPW** cannot mount below the water line and requires **ABOVE** waterline installation, the unit can lift to a maximum height of two feet above the water line, if boost pump is mounted separately below water line. When set up in this manner, install a check valve in the suction line to maintain adequate system priming. Locating the system any more than five feet above the water line requires installation of an external boost pump (Refer to Figure 2). Please **CONSULT** with a VMT service dealer for further technical advisement, if necessary.

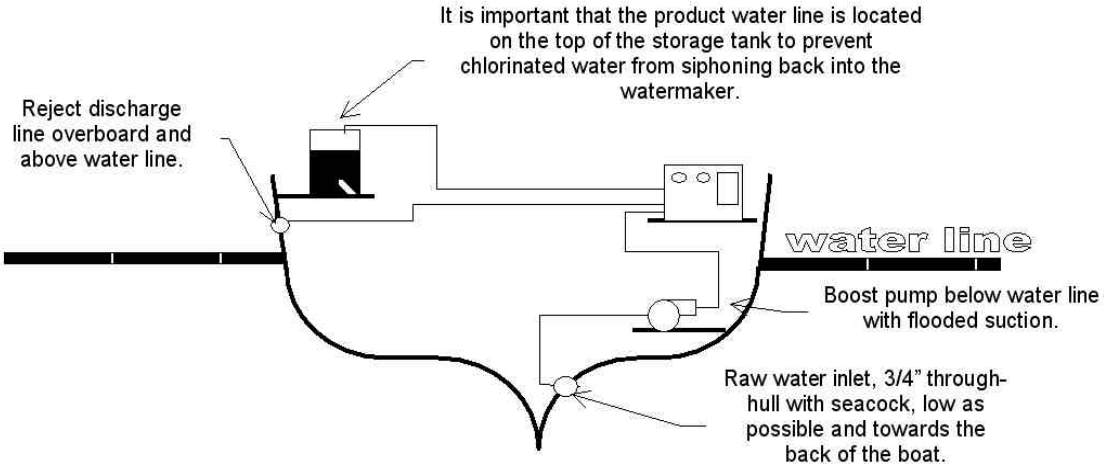

It is important that the product water line is located on the top of the storage tank to prevent chlorinated water from siphoning back into the watermaker.
Reject discharge line overboard and above water line.
water line
Boost pump below water line with flooded suction.
Raw water inlet, 3/4" through-hull with seacock, low as possible and towards the back of the boat.

Figure 2: Recommended Installation Location - ABOVE waterline.

Step 2: Locate or create a ¾" dedicated through-hull for the feedwater intake of the RO unit. The through-hull must be attached with a ball valve (seacock).

⚠ CAUTION

The SPW CANNOT SHARE a through-hull feedwater intake. Village Marine Tec. recommends the Squirt MUST HAVE its OWN dedicated through-hull, to properly feed water into the RO. Avoid connecting the inlet piping to any water line which services an engine or other equipment. Air could be drawn through the unit causing damage to the RO unit's pumps, as well as VOIDING the RO unit's warranty with VMT.

Step 3: Drill a minimum of four mounting holes through the frame and/or mounting base. When drilling, **ALWAYS CHECK** for the drill bit from puncturing/damaging any component of the watermaker and the surrounding mounting area.

Step 4: Optionally, mount and secure the **SPW** with mounting supports (**not supplied with RO unit**) as needed. The supports (Figure 3) minimize noise and vibration when RO unit is in use.

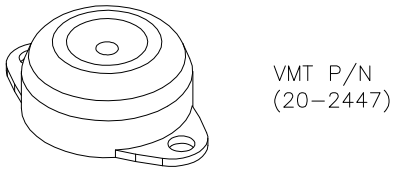


Figure 3: RO Mount Support - Isometric View.

2.1b TO CONNECT PLUMBING

Step 1: Refer to **PAGES 57-58** for the **EXPANDED** detailed **SQUIRT** plumbing diagram.

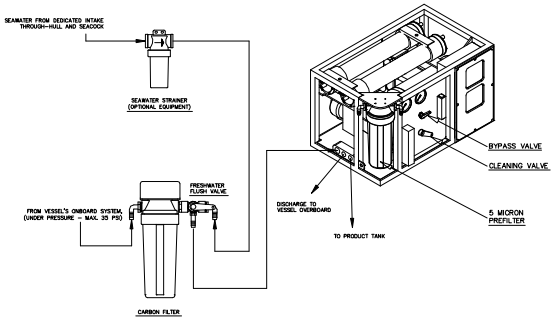

SEAWATER FROM DEDICATED INTAKE THROUGH-HULL AND SEACOCK
SEAWATER STRAINER (OPTIONAL EQUIPMENT)
FRESHWATER FLUSH VALVE
FROM VESSEL'S ONBOARD SYSTEM (UNDER PRESSURE – MAX. 35 PSI)
CARBON FILTER
BYPASS VALVE
CLEANING VALVE
DISCHARGE TO VESSEL OVERBOARD
TO PRODUCT TANK
5 MICRON PREFILTER

Figure 4: SQUIRT Plumbing Diagram.

Step 2: Refer to Figure 5 for the **SQUIRT** manifold port identification.

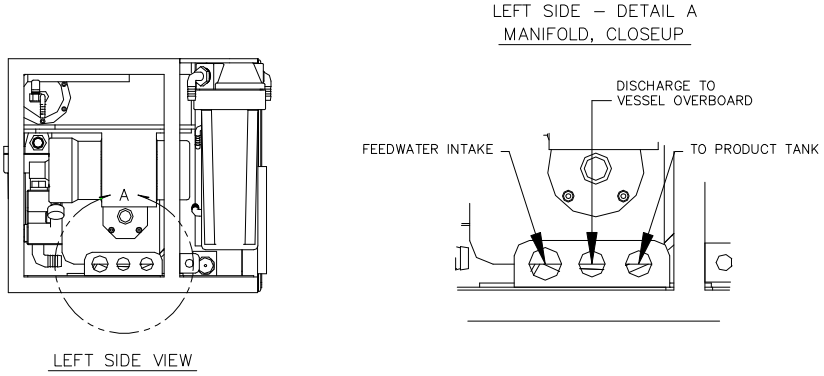


Figure 5: SQUIRT Manifold – Left View.

FEEDWATER INTAKE

Units with <u>MANUAL</u> Freshwater Flush Assembly:

<u>Step 1</u>: Mount the optional sea strainer **BELOW** the vessel's waterline.

<u>Step 2</u>: Mount the three-way manual Freshwater Flush Valve (attached to the Carbon Filter Housing) **BELOW** waterline. Refer to Figure 6 for views of the Carbon Filter and Freshwater Flush Valve.

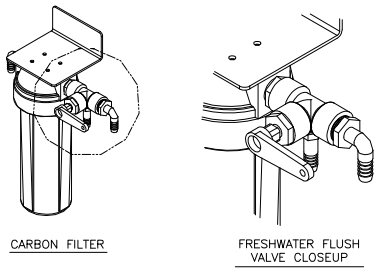


Figure 6: Carbon Filter with Freshwater Flush Valve – Isometric Views.

<u>NOTE</u>: Village Marine Tec. recommends the Manual Freshwater Flush Assembly be installed BELOW waterline. However, the valve can be removed from the filter housing and relocated below waterline. Doing so, a hose can be plumbed to the filter housing from the valve, so that the valve is below waterline. It is MANDATORY for the Freshwater Flush Valve be installed BELOW waterline to avoid trapping air and creating a problem in the feedwater path.

<u>Step 3</u>: Locate your RO unit's dedicated feedwater intake through-hull that is **BELOW** waterline.

<u>Step 4</u>: Connect a ¾" inner diameter PVC hose, from the RO's dedicated intake through-hull, to the sea strainer's INLET.

<u>Step 5</u>: Connect a ¾" inner diameter PVC hose from the sea strainer's OUTLET, to one side of the three-way flush valve (a ½" gray valve) **<u>MOUNTED BELOW</u>** waterline. Refer to Figure 7.

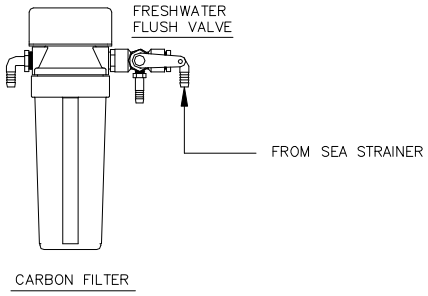


Figure 7: Sea Strainer Connection to Carbon Filter

<u>Step 6</u>: Connect a ¾" hose from the center of the flush valve (½" gray valve) to the ¾" tee before the Low Pressure Boost Pump. Refer to Figure 8**.**

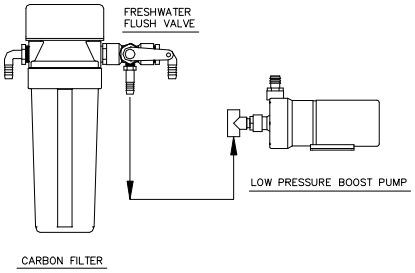


Figure 8: Freshwater Flush Connection to Tee and Low Pressure Boost Pump.

Units with <u>AUTOMATIC</u> Freshwater Flush Assembly:

<u>Step 1</u>: Mount the optional sea strainer **BELOW** the vessel's waterline.

<u>Step 2</u>: Mount the Automatic Freshwater Flush Valve Assembly **BELOW** waterline. Refer to Figure 9 for views of the Carbon Filter and the Freshwater Flush Solenoid Valve.

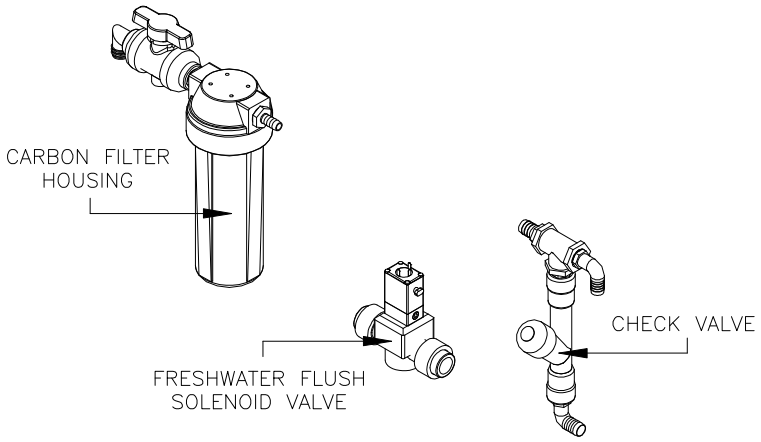


Figure 9: Carbon Filters with Freshwater Flush Solenoid Valve – Isometric Views.

Refer to Figure 10 for a diagram of the Automatic Freshwater Flush Assembly.

<u>NOTE</u>: Village Marine Tec. recommends the Freshwater Flush Valve Assembly be installed BELOW waterline. However, the solenoid valve and carbon filter housing can be relocated at or above waterline, if necessary. It is MANDATORY for the Check Valve be installed BELOW waterline to avoid trapping air and creating a problem in the feedwater path.

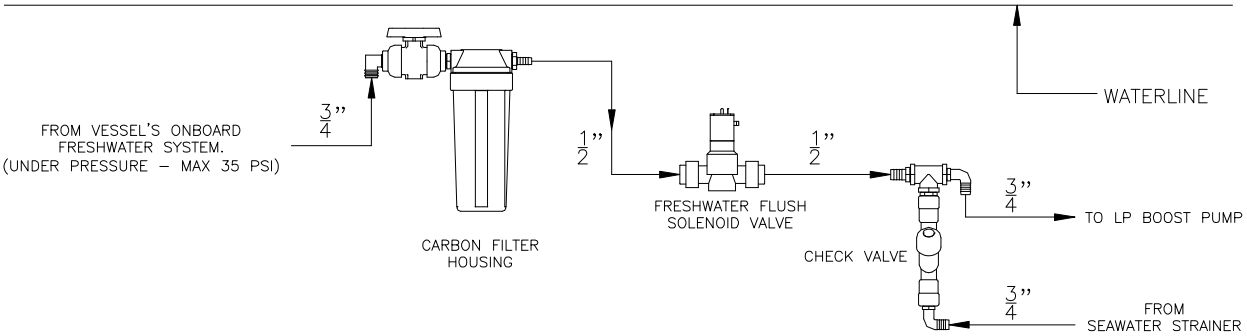


Figure 10: Automatic Freshwater Flush Valve Assembly Diagram with Hose Sizes.

<u>Step 3</u>: Locate your RO unit's dedicated feedwater intake through-hull that is **<u>BELOW</u>** waterline.

<u>Step 4</u>: Connect a ¾" inner diameter PVC hose, from the RO's dedicated intake through-hull, into the elbow off of the freshwater flush solenoid valve **<u>MOUNTED BELOW</u>** waterline (Refer to Figure 10).

<u>Step 5</u>: Connect a ¾" inner diameter PVC hose from the elbow off of the Check Valve's outlet, to the tee of the Low Pressure Boost Pump (Refer to Figure 10).

BRINE DISCHARGE

<u>Step 1</u>: Locate a convenient spot in the boat to install an overboard through-hull with a ½" inner diameter hole. Discharge line is required to be **<u>ABOVE</u>** waterline. Refer to Figure 1.

<u>Step 2</u>: Connect a ½" inner diameter PVC hose from the overboard through-hull to the discharge port of the **SQUIRT**. Refer to **PAGES 57-58** and Figures 5 and 11.

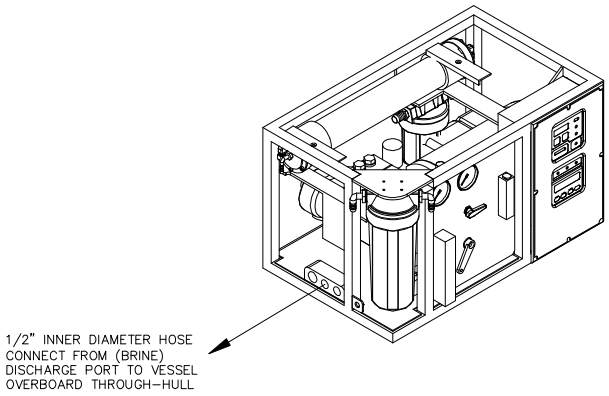


Figure 11: SQUIRT Brine Connection Overboard.

PRODUCT WATER

Step 1: Connect a ½" inner diameter PVC hose (or potable water hose) from the product hose of the manifold, Refer to Figure 12) to the top of the ship's Freshwater Tank (Refer to Figure 1 and Pages 57-58).

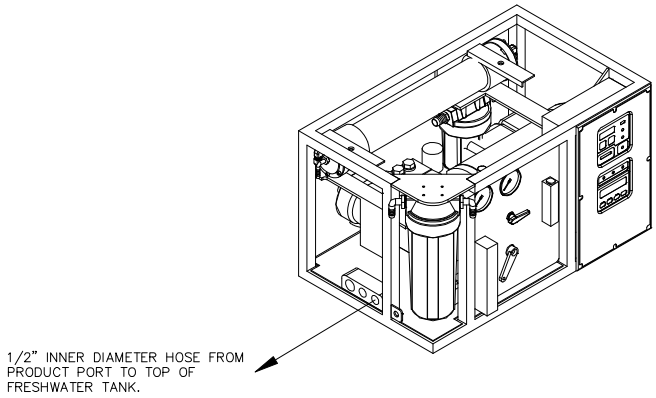


Figure 12: SQUIRT Product Water Hose Connection.

The product water hose line must go into the top of the product tank to prevent any possible back flow. Village Marine Tec. recommends teeing into the tank vent or fill line.

FRESHWATER FLUSH

Units with MANUAL Freshwater Flush:

Step 1: Tap into your boat's freshwater pressure system. (Tee into the cold pressurized side).

Step 2: Run a ½" hose from the tee to the carbon filter inlet (Refer to Figure 13 and Pages 57-58).

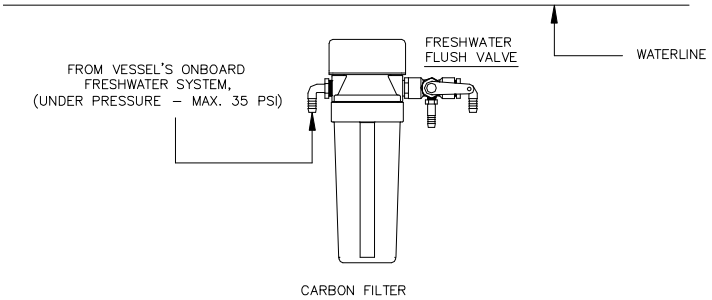


Figure 13: Freshwater Hose Connection into Freshwater Flush Assembly Inlet.

Step 3: **If the Freshwater Flush Valve is ATTACHED to the Carbon Filter Assembly:**
Proceed to the next section, 2.1c

If the Freshwater Flush Valve is SEPARATED from the Carbon Filter Assembly:
Connect a ¾" hose from the carbon filter outlet to one side of the ½" gray flush valve with ¾" hose barbs (Refer to Figure 14) and proceed to the next section, 2.1c

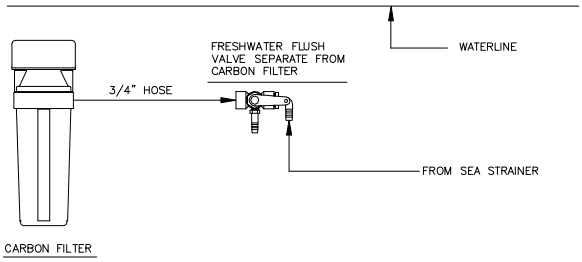


Figure 14: Carbon Filter Outlet Connection to the Separated Freshwater Flush Valve.

Units with AUTOMATIC Freshwater Flush:

Step 1: Tap into your boat's freshwater pressure system. (Tee into the cold pressurized side).

Step 2: Run a ¾" hose from the tee to the carbon filter inlet (Refer to Figure 15 and **PAGES 57-58**).

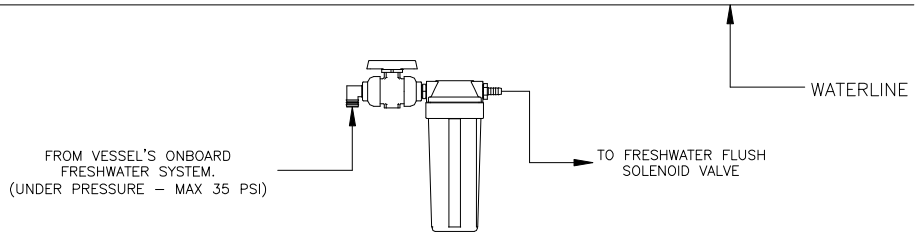


Figure 15: Freshwater Hose Connection into Freshwater Flush Assembly Inlet.

2.1c TO CONNECT THE ELECTRICAL

TURN OFF ALL ELECTRICAL POWER FOR USE WITH THE RO UNIT PRIOR TO CONNECTING TO THE RO POWER SOURCE. FAILURE TO DO SO MAY RESULT IN SERIOUS INJURY OR DEATH TO PERSONS HANDLING THE UNIT.

NOTE: **Adhere to all electrical codes and regulations governing the installation and wiring of electrical equipment. Typical codes specify the type and size of conduit, wire diameter, and class or wire insulation depending upon the amperage and environment.**

NOTE: **The power supply should always be of greater service rating than the requirements of the RO unit. This will assure proper voltage even if power supply voltage is slightly less than required. Never connect the RO unit to a line that services another electrical device. THE RO UNIT SHOULD HAVE ITS OWN INDEPENDENT POWER SUPPLY**.

Step 1: Verify all power switches and power sources are in the ***OFF*** position.

NOTE: VMT recommends use of a **25 amp** fuse or circuit breaker for **110 Volts** AC units.
VMT recommends use of a **15 amp** fuse or circuit breaker for **220 Volts** AC units.

Step 2: For the electrical connections, refer to **Section 10.0: DRAWINGS AND DIAGRAMS** for electrical schematics and wiring diagrams of the **SQUIRT**.

Carefully refer the schematics and wiring diagrams for the **SQUIRT** to the **CORRESPONDING VOLTAGE, PHASE, AND HERTZ** of your RO unit.

Contact your Squirt place of purchase or dealer for further technical advisement if necessary.

2.2a TO INSTALL THE SQUIRT MODULAR (MPW) UNIT

Step 1: Village Marine Tec. recommends installing the RO unit in a dry sheltered location at or aft of midship, with drainage underneath (to draw off standing water when performing routine maintenance or service). Also, the RO unit should be installed **BELOW** waterline (Refer to Figure 16). Give consideration to extra space around the RO unit, allowing access for the unit's maintenance (i.e. membrane replacement, oil change, prefilter replacement, or other service).

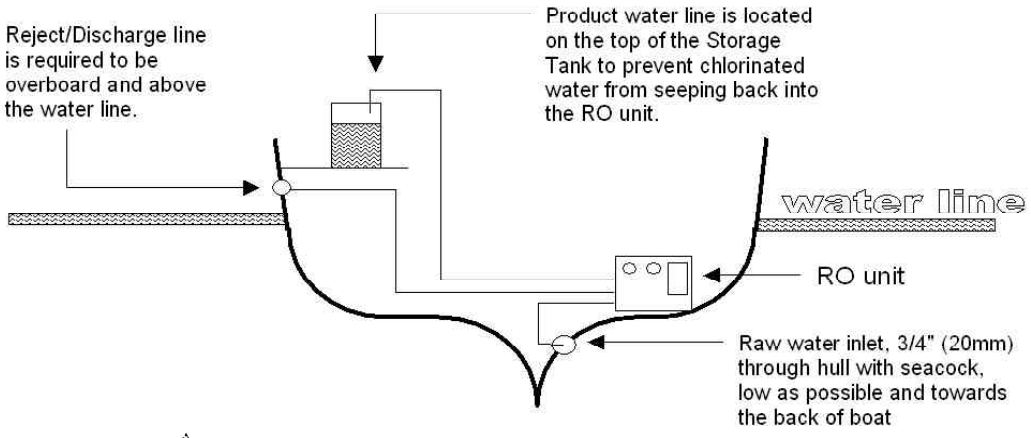

Reject/Discharge line is required to be overboard and above the water line.
Product water line is located on the top of the Storage Tank to prevent chlorinated water from seeping back into the RO unit.
water line
RO unit
Raw water inlet, 3/4" (20mm) through hull with seacock, low as possible and towards the back of boat

Figure 16: Recommended installation BELOW waterline.

If the **MPW** cannot mount below the water line and requires **ABOVE** waterline installation, the unit can lift to a maximum height of two feet above the water line, if boost pump is mounted separately below water line. When set up in this manner, install a check valve in the suction line to maintain adequate system priming. Locating the system any more than five feet above the water line requires installation of an external boost pump (Refer to Figure 17). Please **CONSULT** with a VMT service dealer for further technical advisement, if necessary.

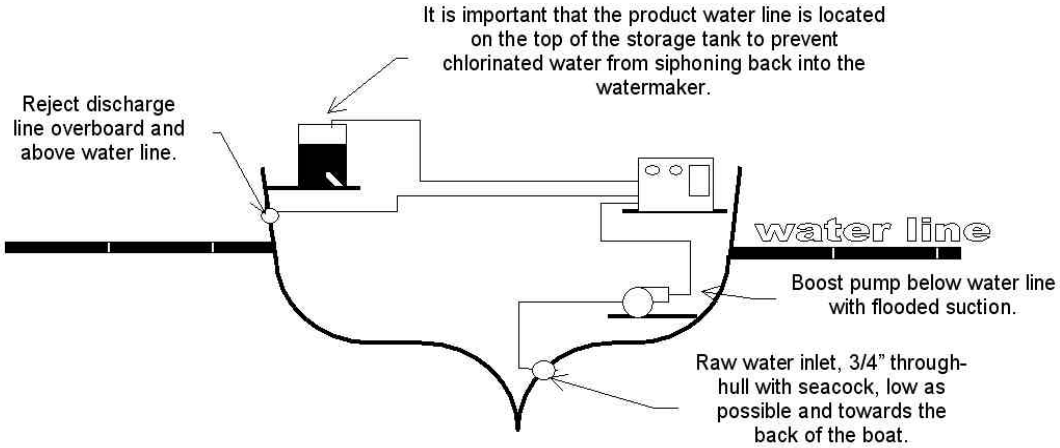

It is important that the product water line is located on the top of the storage tank to prevent chlorinated water from siphoning back into the watermaker.
Reject discharge line overboard and above water line.
water line
Boost pump below water line with flooded suction.
Raw water inlet, 3/4" through-hull with seacock, low as possible and towards the back of the boat.

Figure 17: Recommended Installation Location - ABOVE waterline.

Step 2: Locate or create a ¾" dedicated through-hull for the feedwater intake of the RO unit. The through-hull must be attached with a ball valve (seacock).

⚠ CAUTION

The MPW CANNOT SHARE a through-hull feedwater intake. Village Marine Tec. recommends the MPW MUST HAVE its OWN dedicated through-hull, to properly feed water into the RO. Avoid connecting the inlet piping to any water line which services an engine or other equipment. Air could be drawn through the unit causing damage to the RO unit's pumps, as well as VOIDING the RO unit's warranty with VMT.

Step 3: Drill a minimum of four mounting holes through the frame and/or mounting base. When drilling, **ALWAYS CHECK** for the drill bit from puncturing/damaging any component of the watermaker and the surrounding mounting area.

Step 4: Optionally, mount and secure the **MPW** with mounting supports (**not supplied with RO unit**) as needed. The supports (Figure 18) minimize noise and vibration when RO unit is in use.

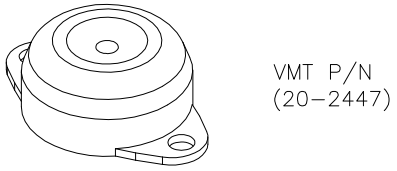


Figure 18: RO Mount Support - Isometric View.

2.2b TO CONNECT PLUMBING

Step 1: Refer to **PAGES 59-60** for the **EXPANDED** detailed **Squirt MODULAR** plumbing diagram.

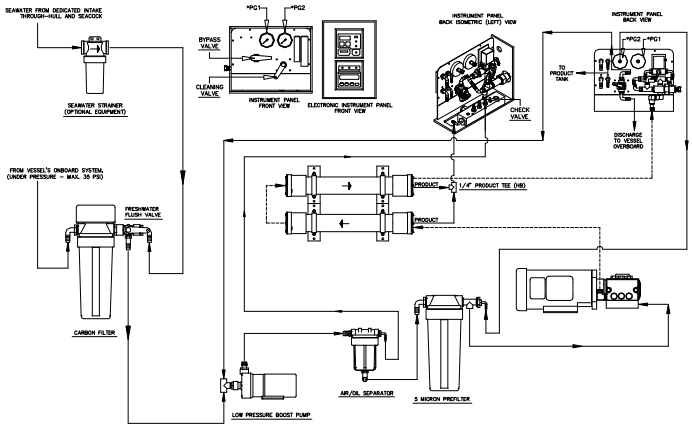


Figure 19: Squirt MODULAR Plumbing Diagram.

FEEDWATER INTAKE

Units with MANUAL Freshwater Flush Assembly:

Step 1: Mount the optional sea strainer **BELOW** the vessel's waterline.

Step 2: Mount the three-way manual Freshwater Flush Valve (attached to Carbon Filter Housing) **BELOW** waterline. Refer to Figure 20 for a view of the carbon filter and freshwater flush valve.

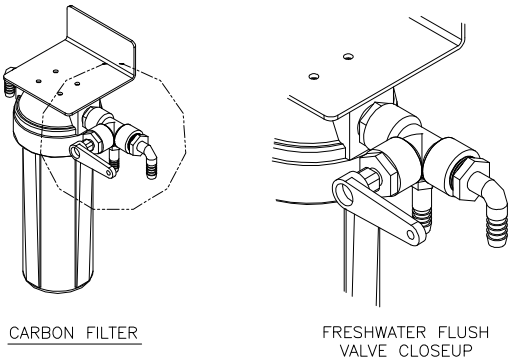


Figure 20: Carbon Filter with Three-Way Freshwater Flush Valve.

NOTE: **Village Marine Tec. recommends the Manual Freshwater Flush Assembly be installed BELOW waterline. However, the valve can be removed from the filter housing and relocated below waterline. Doing so, a hose can be plumbed to the filter housing from the valve, so that the valve is below waterline. It is MANDATORY for the Freshwater Flush Valve be installed BELOW waterline to avoid trapping air and creating a problem in the feedwater path.**

Step 3: Locate your RO unit's dedicated feedwater intake through-hull that is below waterline.

Step 4: Connect a ¾" inner diameter PVC hose, from the RO's dedicated intake through-hull, to the sea strainer's INLET.

Step 5: Connect a ¾" inner diameter PVC hose from the sea strainer's OUTLET, to one side of the three-way flush valve (a ½" gray valve with ¾" hose barbs) **MOUNTED BELOW** waterline.

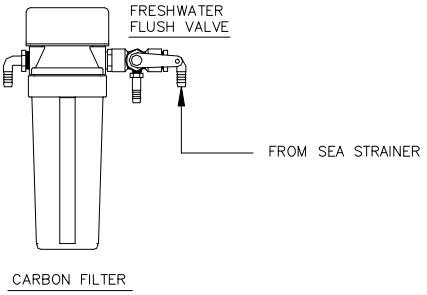


Figure 21: Connection Between Freshwater Flush and Sea Strainer.

Step 6: Connect a ¾" hose from the ½" gray flush valve to the tee of the Low Pressure Boost Pump. Refer to Figure 22 and Pages 59-60.

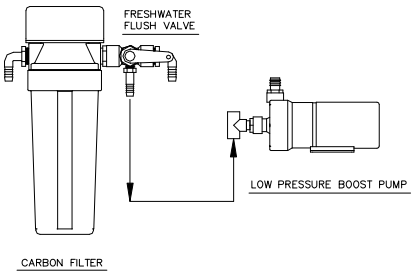


Figure 22: Connection Between Freshwater Flush and Low Pressure Boost Pump.

Units with AUTOMATIC Freshwater Flush Assembly:

Step 1: Mount the optional sea strainer **BELOW** the vessel's waterline.

Step 2: Mount the Automatic Freshwater Flush Valve Assembly BELOW waterline. Refer to Figure 23 for views of the Carbon Filter and the Freshwater Flush Solenoid Valve.

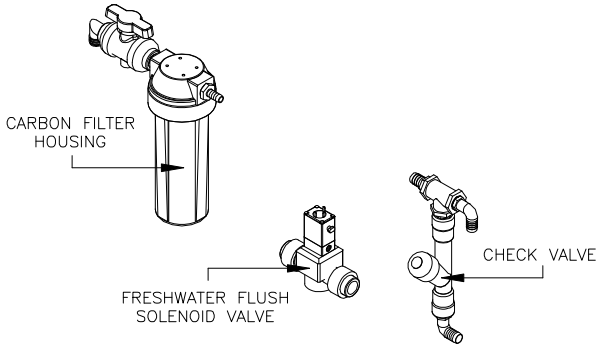


Figure 23: Carbon Filters with Freshwater Flush Solenoid Valve – Isometric Views.

Refer to Figure 24 for a diagram of the Automatic Freshwater Flush Assembly.

NOTE: **Village Marine Tec. recommends the Freshwater Flush Valve Assembly be installed BELOW waterline. However, the solenoid valve and carbon filter housing can be relocated at or above waterline, if necessary. It is MANDATORY for the Check Valve be installed BELOW waterline to avoid trapping air and creating a problem in the feedwater path.**

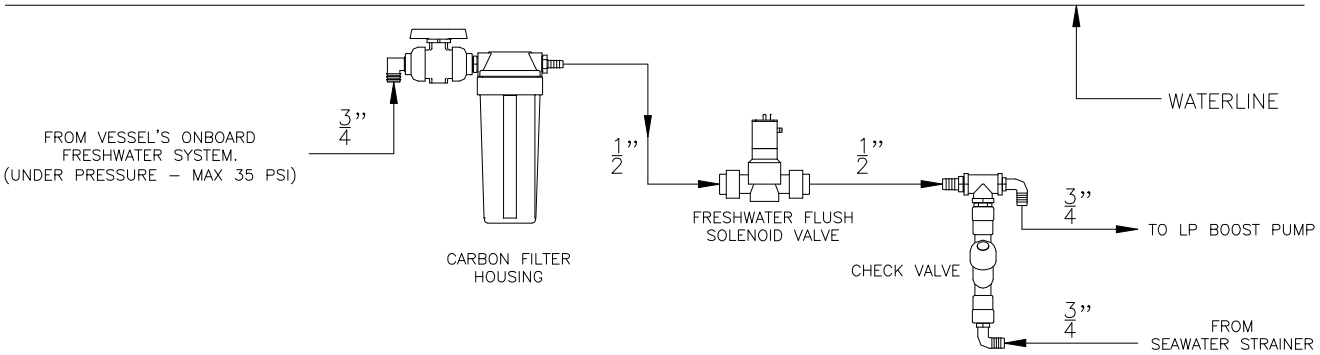


Figure 24: Automatic Freshwater Flush Valve Assembly Diagram with Hose Sizes.

Step 2: Locate your RO unit's dedicated feedwater intake through-hull that is **BELOW** waterline.

Step 3: Connect a ¾" inner diameter PVC hose, from the RO's dedicated intake through-hull, into the elbow off of the freshwater flush solenoid valve **MOUNTED BELOW** waterline (Refer to Figure 24).

Step 4: Connect a ¾" inner diameter PVC hose from the elbow off of the Check Valve's outlet, to the tee of the Low Pressure Boost Pump (Refer to Figure 24).

BRINE DISCHARGE

Step 1: Locate a convenient spot in the boat to install an overboard through-hull (½" inner diameter). Discharge line is required to be **ABOVE** waterline. Refer to Figure 16.

Step 2: Connect a PVC hose (½" inner diameter) from the through-hull to the discharge elbow on the Cleaning Valve of the **MPW**. Refer to **PAGES 59-60** and Figure 25.

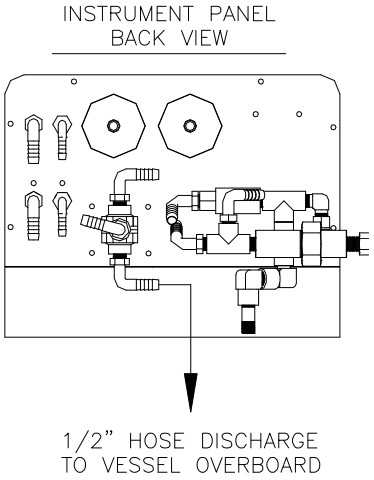


Figure 25: Brine Discharge Connection Overboard.

PRODUCT WATER

Step 1: Connect a PVC hose (or potable water hose) from the product port off of the back of the product flowmeter to the top of the ship's Freshwater Tank (Refer to Figure 26 and Pages 59-60 for hose sizes).

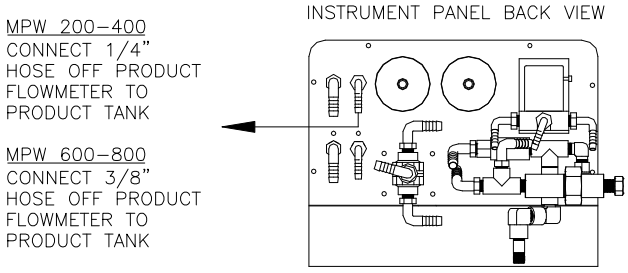


Figure 26: Product Water Hose Connection View.

The product water hose line must go into the top of the tank to prevent any possible backflow. Village Marine Tec. recommends teeing into the tank vent or fill line.

FRESHWATER FLUSH

Units with MANUAL Freshwater Flush:

Step 1: Tap into your boat's freshwater pressure system. (tee into the cold pressurized side).

Step 2: Run a ¾" hose from the tee to the carbon filter inlet (Refer to Figure 27).

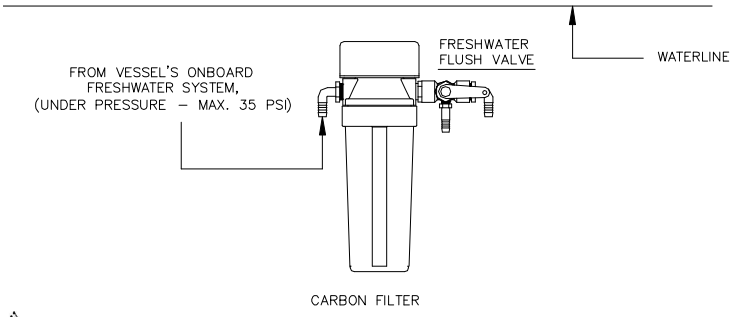


Figure 27: Freshwater Hose Connection into Freshwater Flush Assembly Inlet.

Step 3: **If the Freshwater Flush Valve is ATTACHED to the Carbon Filter Assembly:**
Proceed to the next section, 2.2c

If the Freshwater Flush Valve is SEPARATED from the Carbon Filter Assembly:
Connect a ¾" hose from the carbon filter outlet to one side of the ½" gray flush valve with ¾" hose barbs and proceed to the next section, 2.2c (Refer to Figure 28).

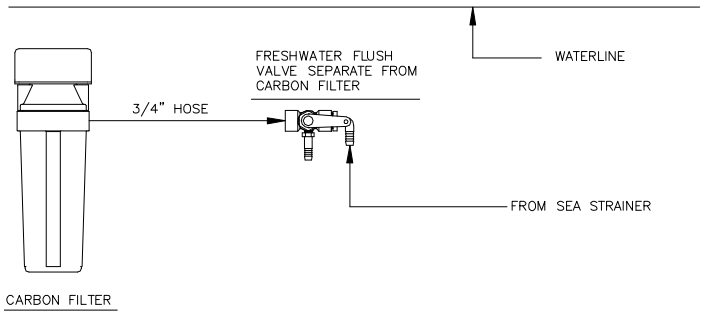


Figure 28: Carbon Filter Outlet Connection to the Separated Freshwater Flush Valve.

Units with <u>AUTOMATIC</u> Freshwater Flush:

<u>Step 1</u>: Tap into your boat's freshwater pressure system. (Tee into the cold pressurized side).

<u>Step 2</u>: Run a ¾" hose from the tee to the carbon filter inlet (Refer to Figure 29 and **PAGES 59-60**).

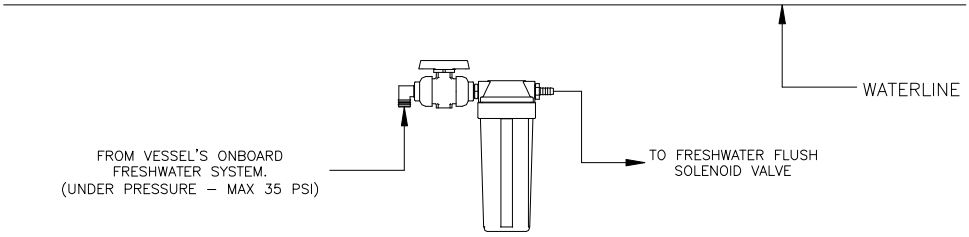


Figure 29: Freshwater Hose Connection into Freshwater Flush Assembly Inlet.

2.2c <u>TO CONNECT THE ELECTRICAL</u>

TURN OFF ALL ELECTRICAL POWER FOR USE WITH THE RO UNIT PRIOR TO CONNECTING TO THE RO POWER SOURCE. FAILURE TO DO SO MAY RESULT IN SERIOUS INJURY OR DEATH TO PERSONS HANDLING THE UNIT.

<u>**NOTE**</u>: **Adhere to all electrical codes and regulations governing the installation and wiring of electrical equipment. Typical codes specify the type and size of conduit, wire diameter, and class or wire insulation depending upon the amperage and environment.**

<u>**NOTE:**</u> **The power supply should always be of greater service rating than the requirements of the RO unit. This will assure proper voltage even if power supply voltage is slightly less than required. Never connect the RO unit to a line that services another electrical device. <u>THE RO UNIT SHOULD HAVE ITS OWN INDEPENDENT POWER SUPPLY</u>**.

<u>Step 1</u>: Verify all power switches and power sources are in the ***<u>OFF</u>*** position.

<u>**NOTE**</u>: VMT recommends use of a **25 amp** fuse or circuit breaker for **110 Volts** AC units.
VMT recommends use of a **15 amp** fuse or circuit breaker for **220 Volts** AC units.

<u>Step 2</u>: For the electrical connections, refer to **Section 10.0: <u>DRAWINGS AND DIAGRAMS</u>** for electrical schematics and wiring diagrams of the **Squirt MODULAR**.

Carefully refer the schematics and diagrams for the **Squirt MODULAR** to the **CORRESPONDING <u>VOLTAGE, PHASE, AND HERTZ</u>** of your RO unit.

Contact your Squirt place of purchase or dealer, for further technical advisement if necessary.

2.3a TO INSTALL THE STOWAWAY UNIT

Step 1: Village Marine Tec. recommends installing the RO unit in a dry sheltered location at or aft of midship, with drainage underneath (to draw off standing water when performing routine maintenance or service). Also, the RO unit should be installed **BELOW** waterline (Refer to Figure 30). Give consideration to extra space around the RO unit, allowing access for the unit's maintenance (i.e. membrane replacement, oil change, prefilter replacement, or other service).

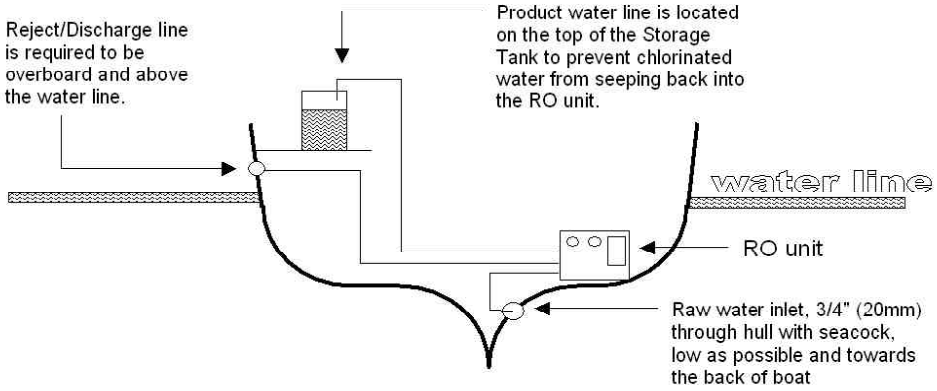

Reject/Discharge line is required to be overboard and above the water line.
Product water line is located on the top of the Storage Tank to prevent chlorinated water from seeping back into the RO unit.
water line
RO unit
Raw water inlet, 3/4" (20mm) through hull with seacock, low as possible and towards the back of boat

Figure 30: Recommended installation BELOW waterline.

If the **STOWAWAY** cannot mount below the water line and requires **ABOVE** waterline installation, the unit can lift to a maximum height of two feet above the water line, if boost pump is mounted separately below water line. When set up in this manner, install a check valve in the suction line to maintain adequate system priming. Locating the system any more than five feet above the water line requires installation of an external boost pump (Refer to Figure 31). Please **CONSULT** with a VMT service dealer for further technical advisement, if necessary.

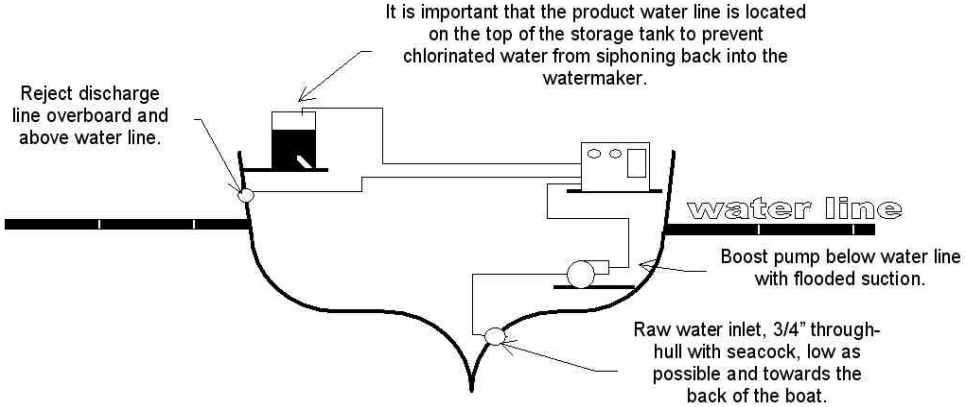

It is important that the product water line is located on the top of the storage tank to prevent chlorinated water from siphoning back into the watermaker.
Reject discharge line overboard and above water line.
water line
Boost pump below water line with flooded suction.
Raw water inlet, 3/4" through-hull with seacock, low as possible and towards the back of the boat.

Figure 31: Recommended Installation Location – ABOVE waterline.

Step 2: Locate or create a ¾" dedicated through-hull for the feedwater intake of the RO unit. The through-hull must be attached with a screen and ball valve (seacock).

⚠ CAUTION

The STOWAWAY CANNOT SHARE a through-hull feedwater intake. Village Marine Tec. recommends the Stowaway MUST HAVE its OWN dedicated through-hull, to properly feed water into the RO. Avoid connecting the inlet piping to any water line which services an engine or other equipment. Air could be drawn through the unit causing damage to the RO unit's pumps, as well as VOIDING the RO unit's warranty with VMT.

Step 3: Drill a minimum of four mounting holes through the frame and/or mounting base. When drilling, **ALWAYS CHECK** for the drill bit from puncturing/damaging any component of the watermaker and the surrounding mounting area.

Step 4: Optionally, mount and secure the **STOWAWAY** with four mounting supports (**not supplied with RO unit**). The supports (Figure 32) minimize noise and vibration when RO unit is in use.

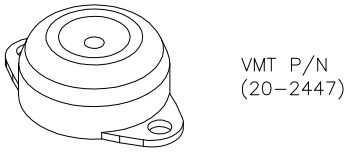


Figure 32: RO Mount Support - Isometric View.

2.3b TO CONNECT PLUMBING

Step 1: Refer to **PAGE 61** for the **EXPANDED** detailed **STOWAWAY** plumbing diagram.

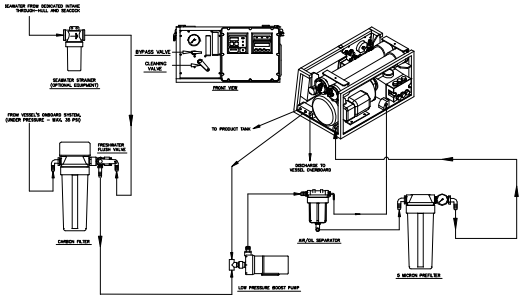


Figure 33: STOWAWAY Plumbing Diagram.

Step 1: Refer to Figure 34 for the **STOWAWAY** manifold port identification.

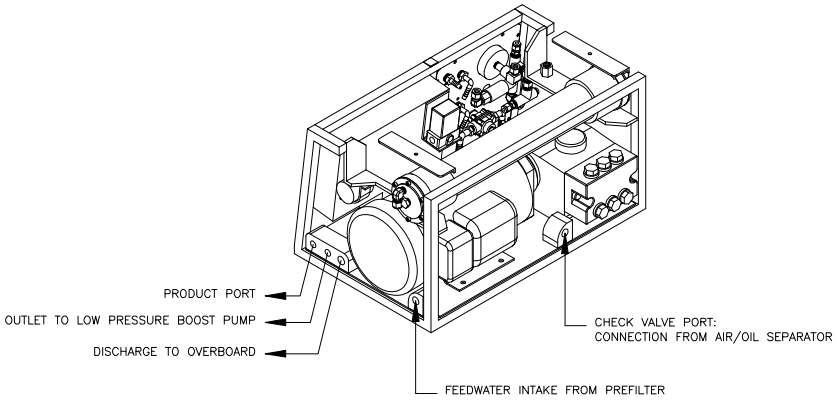


Figure 34: STOWAWAY Manifold - Right View.

FEEDWATER INTAKE

Units with MANUAL Freshwater Flush Assembly:

Step 1: Mount the optional sea strainer **BELOW** the vessel's waterline.

Step 2: Mount the three-way manual Freshwater Flush Valve (attached to Carbon Filter Housing) **BELOW** waterline. Refer to Figure 35 for views of the Carbon Filter and the Freshwater Flush Valve.

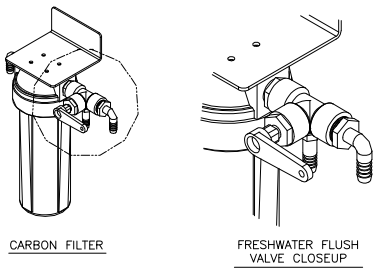


Figure 35: Carbon Filter with Freshwater Flush Valve – Isometric Views.

NOTE: Village Marine Tec. recommends the Manual Freshwater Flush assembly be installed BELOW waterline. However, the valve can be removed from the filter housing and relocated below waterline. Doing so, a hose can be plumbed to the filter housing from the valve, so that the valve is below waterline. It is MANDATORY for the Freshwater Flush Valve be installed BELOW waterline to avoid trapping air and creating a problem in the feedwater path.

Step 3: Locate your RO unit's dedicated feedwater intake through-hull that is **BELOW** waterline.

Step 4: Connect a ¾" inner diameter PVC hose, from the RO's dedicated intake through-hull, to the sea strainer's INLET.

Step 5: Connect a ¾" inner diameter PVC hose from the sea strainer's OUTLET, to one side of the three-way flush valve (a ½" gray valve with ¾" hose barbs) **MOUNTED BELOW** waterline. Refer to **PAGE 64** for detailed connection and Figure 35 for view of the freshwater flush valve.

Step 6: Connect a ¾" hose from the center of the flush valve (½" gray valve with ¾" hose barbs) to the tee of the Low Pressure Boost Pump. Refer to Figure 36**.**

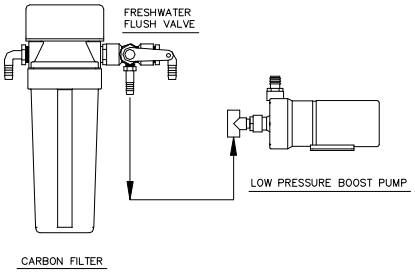


Figure 36: Freshwater Flush Connection to Tee on the Low Pressure Boost Pump.

Units with AUTOMATIC Freshwater Flush Assembly:

Step 1: Mount the optional sea strainer **BELOW** the vessel's waterline.

Step 2: Mount the Automatic Freshwater Flush Valve Assembly BELOW waterline. Refer to Figure 37 for views of the Carbon Filter and the Freshwater Flush Solenoid Valve.

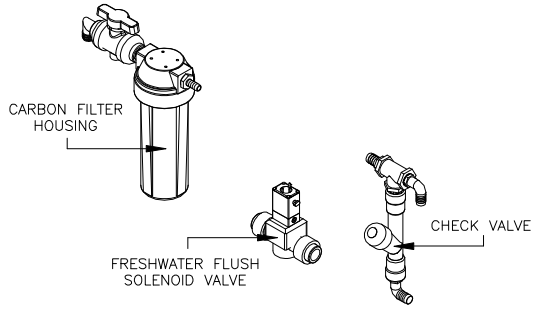


Figure 37: Carbon Filters with Freshwater Flush Solenoid Valve – Isometric Views.

Refer to Figure 38 for a diagram of the Automatic Freshwater Flush Assembly.

NOTE: **Village Marine Tec. recommends the Freshwater Flush Valve Assembly be installed BELOW waterline. However, the solenoid valve and carbon filter housing can be relocated at or above waterline, if necessary. It is MANDATORY for the Check Valve be installed BELOW waterline to avoid trapping air and creating a problem in the feedwater path.**

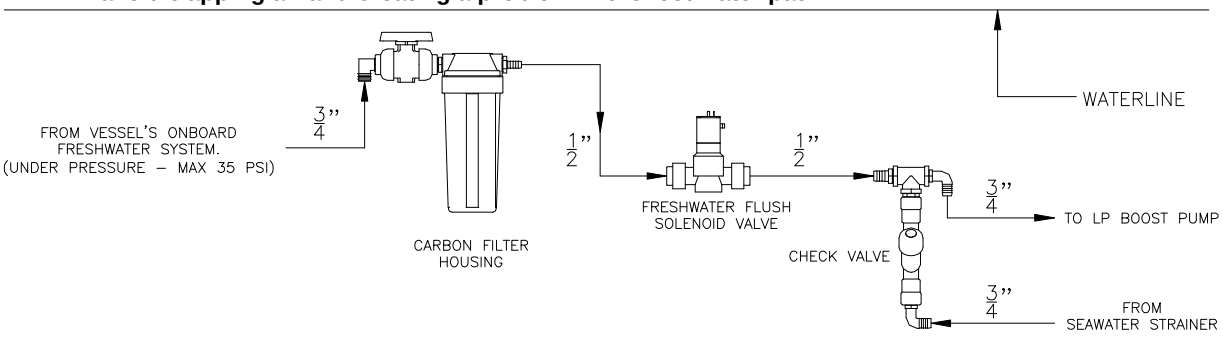


Figure 38: Automatic Freshwater Flush Valve Assembly Diagram with Hose Sizes.

Step 2: Locate your RO unit's dedicated feedwater intake through-hull that is **BELOW** waterline.

Step 3: Connect a ¾" inner diameter PVC hose, from the RO's dedicated intake through-hull, into the elbow off of the freshwater flush solenoid valve **MOUNTED BELOW** waterline (Refer to Figure 38).

Step 4: Connect a ¾" inner diameter PVC hose from the elbow off of the Check Valve's outlet, to the tee of the Low Pressure Boost Pump (Refer to Figure 38).

BRINE DISCHARGE

Step 1: Locate a convenient spot in the boat to install an overboard through-hull (½" inner diameter). Discharge line is required to be **ABOVE** waterline. Refer to Figure 30.

Step 2: Connect a PVC hose (½" inner diameter) from the overboard through-hull, to the discharge port off the **STOWAWAY**. Refer to **PAGE 64** and Figures 30 and 39.

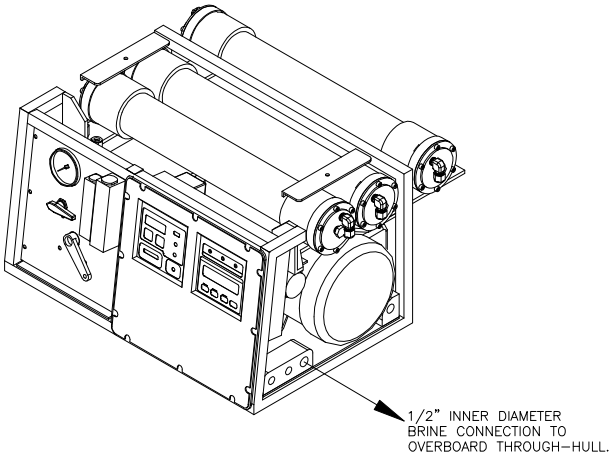


Figure 39: STOWAWAY Brine Connection to Overboard Through-Hull.

PRODUCT WATER

Step 1: Connect a ¼" inner diameter PVC hose (or potable water hose) from the product port of the manifold, (Refer to Figure 40) to the top of the ship's Freshwater Tank (Refer to Figure 30).

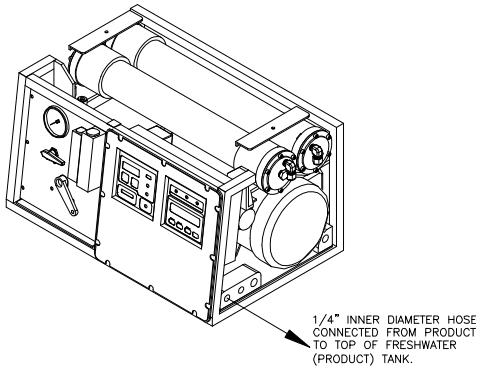


Figure 40: STOWAWAY Product Water Hose Connection.

The product water hose line must go into the top of the product tank to prevent any possible backflow. Village Marine Tec. recommends teeing into the tank vent or fill line.

FRESHWATER FLUSH

Units with <u>MANUAL</u> Freshwater Flush Assembly:

<u>Step 1</u>: Tap into your boat's freshwater pressure system. (Tee into the cold pressurized side).

<u>Step 2</u>: Run a ½" hose from the tee to the carbon filter inlet (Refer to Figure 41 and Page 61).

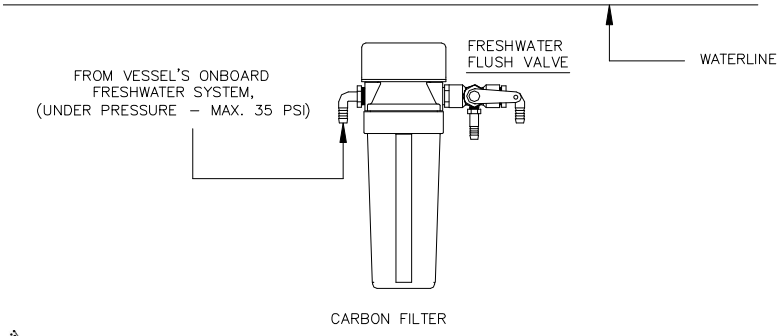


Figure 41: Freshwater Hose Connection into Freshwater Flush Assembly Inlet.

<u>Step 3</u>: **If the Freshwater Flush Valve is ATTACHED to the Carbon Filter Assembly:**
Proceed to the next section, 2.3c.

If the Freshwater Flush Valve is SEPARATED from the Carbon Filter Assembly:
Connect a ¾" hose from the carbon filter outlet to one side of the ½" gray flush valve with ¾" hose barbs and proceed to the next section, 2.3c (Refer to Figure 42).

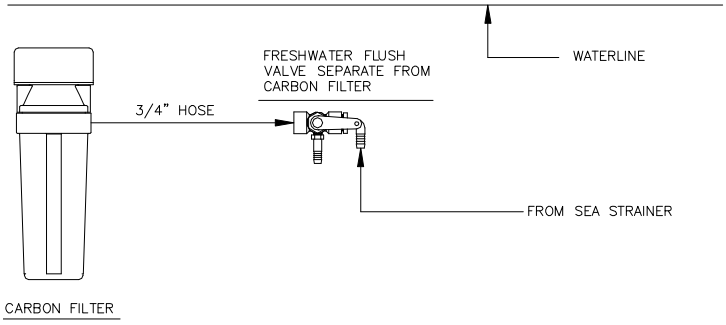


Figure 42: Carbon Filter Outlet Connection to the Separated Freshwater Flush Valve.

Units with AUTOMATIC Freshwater Flush:

Step 1: Tap into your boat's freshwater pressure system. (Tee into the cold pressurized side).

Step 2: Run a ¾" hose from the tee to the carbon filter inlet (Refer to Figure 43 and **PAGE 61**).

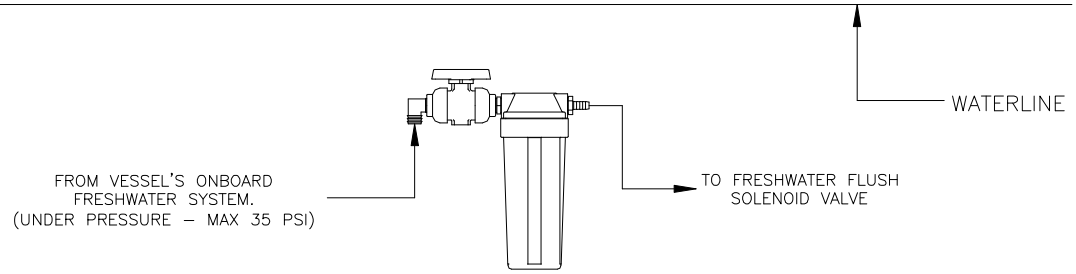


Figure 43: Freshwater Hose Connection into Freshwater Flush Assembly Inlet.

2.3c TO CONNECT THE ELECTRICAL

TURN OFF ALL ELECTRICAL POWER FOR USE WITH THE RO UNIT PRIOR TO CONNECTING TO THE RO POWER SOURCE. FAILURE TO DO SO MAY RESULT IN SERIOUS INJURY OR DEATH TO PERSONS HANDLING THE UNIT.

NOTE: **Adhere to all electrical codes and regulations governing the installation and wiring of electrical equipment. Typical codes specify the type and size of conduit, wire diameter, and class or wire insulation depending upon the amperage and environment.**

NOTE: The power supply should always be of greater service rating than the requirements of the RO unit. This will assure proper voltage even if power supply voltage is slightly less than required. Never connect the RO unit to a line that services another electrical device. THE RO UNIT SHOULD HAVE ITS OWN INDEPENDENT POWER SUPPLY.

Step 1: Verify all power switches and power sources are in the ***OFF*** position.

NOTE: VMT recommends use of a **25 amp** fuse or circuit breaker for **110 Volts** AC units.
VMT recommends use of a **15 amp** fuse or circuit breaker for **220 Volts** AC units.

Step 2: For the electrical connections, refer to **Section 10.0: DRAWINGS AND DIAGRAMS** for electrical schematics and wiring diagrams of the **STOWAWAY**.

Carefully refer the schematics and wiring diagrams for the **STOWAWAY** to the **CORRESPONDING VOLTAGE, PHASE, AND HERTZ** of your RO unit.

Contact your Stowaway place of purchase or dealer for further technical advisement if necessary.

3.0 GENERAL THEORY OF OPERATION

3.1 REVERSE OSMOSIS THEORY

Reverse osmosis, like many other practical scientific methods, developed from processes first observed in nature. Osmosis is a naturally occurring phenomenon in which a semi-permeable membrane separates a pure and a concentrated solution (a semi-permeable membrane is defined as one that preferentially passes a particular substance). Every fluid has an inherent potential that is directly related to the type and amount of solids in solution. This potential, referred to as osmotic pressure, increases in proportion to relative concentration of a solution. A concentrated solution, therefore, has an osmotic pressure that is higher than that of a pure solution.

In an osmotic system, the less concentrated solution will attempt to equalize the concentrations of both solutions by migrating across the semi-permeable membrane. When enough pure solution migrates across the membrane such that the inherent potential difference between the solutions in no longer higher than the osmotic pressure of the membrane, the purer solution will stop flowing. If the pressure on the concentrated solution is increased to above the osmotic pressure, fluid flow will be reversed. This condition, called Reverse Osmosis, can be established by artificially pressurizing the more concentrated solution using a high pressure pump. In this type of system, the concentrated solution (normally referred to as feedwater) will become more concentrated as pure water flows out of solution and across the membrane to the permeate side. Discounting the effects of feedwater temperature and salinity, the operating pressure normally required to produce significant amounts of pure water is at least twice the osmotic pressure of the membrane being used.

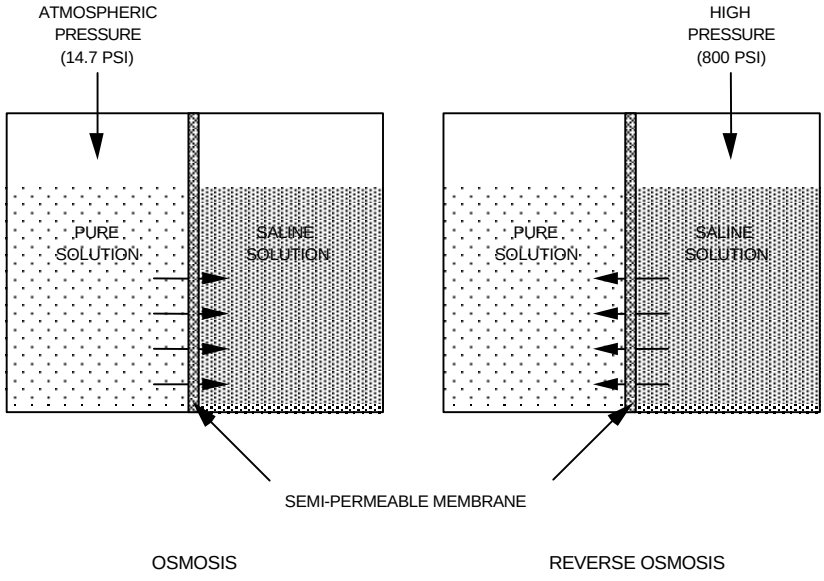


Figure 3.0 - Simple (Reverse) Osmosis Process.

3.2 APPLICATION OF REVERSE OSMOSIS

Seawater contains many kinds of solids dissolved in solution. The most prevalent is common table salt (sodium chloride). Other minerals that may be present in solution are substances that usually contain various compounds of calcium and sulfate. The sum of all of the solids dissolved in a particular sample of water is referred to as *Total Dissolved Solids* or TDS. Seawater normally averages 32,000 ppm (parts per million) TDS although variations of 5000 ppm are common in various parts of the world. The fundamental goal any desalination process is a significant reduction in the amount of dissolved solids in water.

In a Reverse Osmosis desalination system, most of the dissolved solids do not pass through the membrane but are instead carried along the membrane surface. This rejected water, referred to as *brine*, becomes increasingly more concentrated as it flows across the surface of the membranes and is eventually piped to drain. The product water that flows through the membrane is referred to as *permeate*. The percentage of feedwater that enters the unit converted to permeate is called the *recovery rate*. A higher than optimal recovery rate (which can be obtained by increasing the back pressure on the unit above the recommended range) results in greatly increased membrane fouling rates and a significant decrease in the operational life of the membranes.

It should be noted that no system is capable of removing all 100% of the dissolved solids from seawater. Designed to reject approximately 99% of the TDS, the system allows 1% of the 32,000 ppm TDS in the seawater to pass into the product water. This yields product water of less than 500 ppm, the recommended TDS for drinking water. A system such as this is said to have a *salt passage* of 1%.

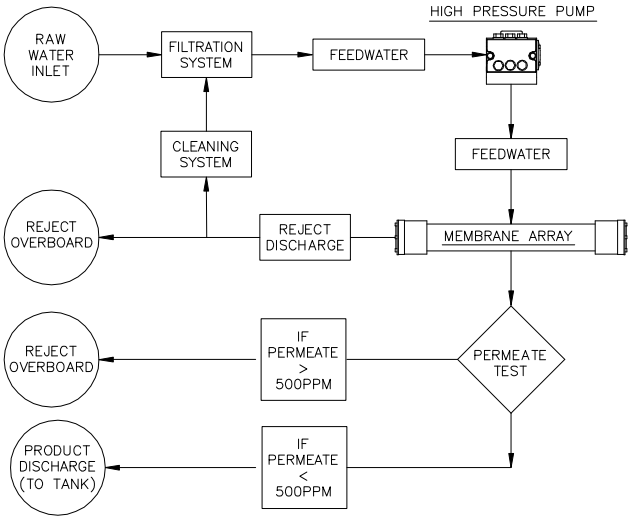


Figure 44: Simplified Schematic of an RO System.

3.3 PRODUCT WATER QUALITY STANDARDS

This RO unit will produce permeate (product water) with a quality of less than 500 ppm TDS and in accordance with World Health Organization (WHO) guidelines for drinking water. General WHO specifications for acceptable drinking water quality are as follows:

Constituent Ion / Molecule	Maximum Limits (ppm)
Nitrate	10
Fluorine	1
Chlorine	250 (per USPHS 1962)
Sulfate	100
Magnesium	30
Calcium	75
Calcium Carbonate	100
Iron	0.1
Manganese	0.05
Total Dissolved Solids	500
Turbidity	5
Oil	0.1
Detergents (Anionic)	0.2
Phenols	0.001
pH	7.5 – 8.5 (per USPHS 1962)
Bacteria – E. Coli (per 100 ml)	0

Table 3.0 - WHO Drinking Water Guidelines.

3.4 FACTORS AFFECTING PERMEATE PRODUCTION

VARIATIONS IN TEMPERATURE, PRESSURE, AND SALINITY

The following table illustrates how the quality and quantity of permeate produced by a RO system is affected by changes in temperature, salinity and pressure:

With constant....	And increasing....	Permeate	
		TDS	Capacity
Salinity and Pressure	Temperature	Increases	Increases
Temperature and Pressure	Salinity*	Increases	Decreases
Temperature and Salinity	Pressure**	Decreases	Increases

Table 3.1 - Factors Affecting Permeate Quality

* If the feedwater salt concentration decreases, the product water flow rate should not be allowed to increase more than 20% above rated flow. Feed pressure may need to be lowered to maintain rated flow in brackish water or tap water applications.

** Feed pressure shall not be increased above 950 psi.

The RO system can be adjusted to maintain a constant permeate output when feedwater temperature and salinity is other than nominal. The operator can do this by controlling system pressure manually via the backpressure regulation valve located in the system brine piping. As permeate flow decreases, the operator can throttle the pressure regulation valve closed to increase system pressure. This, in turn, will increase the permeate output and mitigate the effect of a decrease in temperature or an increase in salinity. Conversely, the operator can open the pressure regulation valve to reduce pressure and permeate flow in areas of excessively high temperature or low salinity.

⚠ WARNING **IN FRESH OR BRACKISH FEEDWATER CONDITIONS, MAKE SURE TO REDUCE PRESSURE BY TURNING REGULATOR. SET PRESSURE SO PRODUCT FLOW IS NO MORE THAN 120% OF DESIGN FLOW TO AVOID MEMBRANE DAMAGE.**

3.4a TEMPERATURE CORRECTION FACTOR

As previously described, the output capacity of any RO unit is highly dependent on feedwater temperature. In order to quantify this relationship, operational data has been utilized to develop Temperature Correction Factors (TCF). The TCF (which is compensated to 25°C/77°F) is used to determine what part of any change in system output flow is due to variations in feedwater temperature alone. This, in turn, allows the operator to establish the baseline flow for a given temperature, allowing more accurate troubleshooting. The procedure for calculating the TCF and the temperature compensated flow is as follows:

1) Measure raw water temperature.
2) Determine the corresponding correction factor from Table 3.2 based on the measured temperature.
3) Note the product flow rate at the Product Flow meter.
4) Multiply the measure (uncorrected) product flow meter flow rate by the correction factor from Table 3.2 to give true system output under standard conditions (25°C).

Example:

Raw water temp:	15°C
TCF:	1.47
Uncorrected product flow:	22.7 (gph)
Calculation:	22.7 x 1.47 = 33.3 (gph)
Corrected product flow:	33.3 (gph)
	(This is the normal flow for a STW 800)

°C	Factor	°C	Factor	°F	Factor	°F	Factor
1	3.64	26	0.97	34	3.47	84	0.88
2	3.23	26	0.94	36	3.18	86	0.82
3	3.03	28	0.91	38	3.18	88	0.79
4	2.78	29	0.88	40	2.68	90	0.79
5	2.58	30	0.85	42	2.47	92	0.77
6	2.38	31	0.83	44	2.29	94	0.75
7	2.22	32	0.80	46	2.14	96	0.73
8	2.11	33	0.77	48	2.01	98	0.70
9	2.00	34	0.75	50	1.88	100	0.68
10	1.89	35	0.73	52	1.77	102	0.65
11	1.78	36	0.71	54	1.68	104	0.63
12	1.68	37	0.69	56	1.59	106	0.61
13	1.61	38	0.67	58	1.51	108	0.59
14	1.54	39	0.65	60	1.44	110	0.57
15	1.47	40	0.63	62	1.36	112	0.55
16	1.39	41	0.61	64	1.30	114	0.53
17	1.34	42	0.60	66	1.24	116	0.51
18	1.29	43	0.58	68	1.17	118	0.49
19	1.24	44	0.56	70	1.12	120	0.47
20	1.19	45	0.54	72	1.08	122	0.45
21	1.15	46	0.53	74	1.05		
22	1.11	47	0.51	76	1.02		
23	1.08	48	0.49	78	1.00		
24	1.04	49	0.47	80	0.93		
25	1.00	50	0.46	82	0.90		

Table 3.2 - Temperature Correction Factors

3.5 OPERATIONAL DESCRIPTION

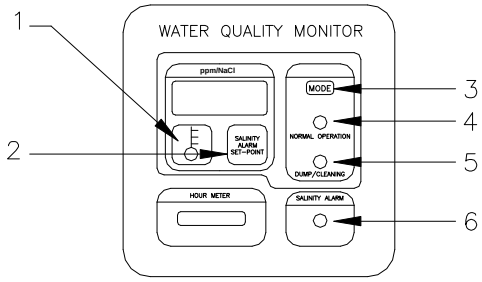


Figure 45: Water Quality Monitor - Panel View.

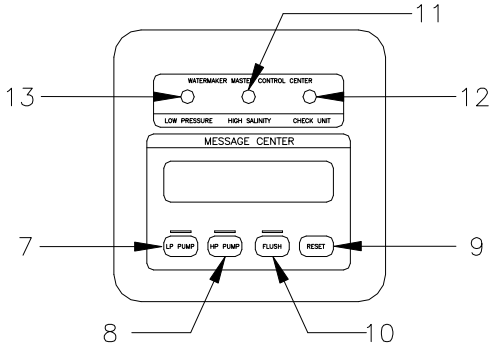


Figure 46: Master Control Center - Panel View.

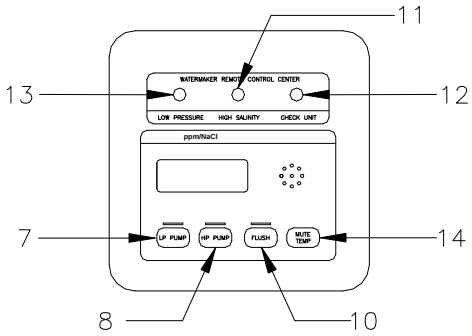


Figure 47: Remote Control Center – Panel View.

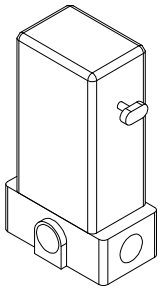


Figure 48: Three-Way Product Valve.

PRODUCT WATER MONITORING SYSTEM

The product water (or permeate) flows past a conductivity sensor which provides a signal to the water quality monitor. Depending on the concentration of total of dissolved solids (TDS) in the permeate, the following occurs:

If the permeate TDS is detected **AT GREATER** than 500 parts per million (ppm), indicating **POOR** quality water), a signal is sent from the water quality monitor (Figure 45), to the three-way product diversion valve (Figure 48) to reroute the (high salinity) water away from your water storage tank(s) and into the reject stream.

If the permeate TDS has **LESS** than 500 ppm, indicating **GOOD** (drinking) water, a signal is sent to the three-way product diversion valve to redirect the good permeate through a flowmeter and finally into your water storage tank(s).

MASTER CONTROL CENTER

The Master Control Center (MCC) provides centralized control and monitoring of all important unit functions and operating parameters (Figure 46). This is achieved through the use of a fully integrated package of control pushbuttons and alarm/status lights, as well as an easy to read Message Display console.

REMOTE CONTROL CENTER

Installed as an option, the Remote Control Center (RCC) provides remote control and monitoring of all important unit functions and operating parameters (Figure 47) from a remote location. The RCC has a similar configuration as the MCC with the exception of the Message Center and Reset Pushbutton.

PUSHBUTTON AND DISPLAY DESCRIPTIONS

Refer to the numerical callouts of Figures 45-47 for reference of the following pushbutton and displays explanation of the Water Quality Monitor, Master Control Center, and Remote Control Center panels.

WATER QUALITY MONITOR (WQM)

(1) **TEMPERATURE**
Allows the operator to display permeate temperature (as opposed to the normal permeate salinity display). By adjusting the jumper on the back of the monitor, the temperature can be displayed in Fahrenheit (°F) or Celsius (°C).

(2) **SALINITY ALARM SET POINT**
Allows the operator to display and change (via a control knob located on the back panel of the monitor), the salinity alarm set point.

(3) **MODE**
Allows the operator to bypass the normal automatic operation and manually de-energize (dump) the product valve toward the storage tanks.

(4) **NORMAL OPERATION**
An illuminated green light activates when the product valve is energized and product water is flowing through the product valve.

(5) **DUMP/CLEANING**
An illuminated yellow light activates when the product valve is de-energized and the product valve is directing permeate to the reject line.

(6) **SALINITY ALARM**
An illuminated red light indicates product water quality is above the WQM salinity set point.

MASTER CONTROL CENTER (MCC) AND REMOTE CONTROL CENTER (RCC)

(7) **LP PUMP** (Low Pressure Pump)
Controls the operation (ON/OFF) of the low pressure boost pump and energizes a light indicating when the pump is operating. When only the LP boost pump is running, it signals the MCC to display the message "**LP PUMP ON**".

(8) **HP PUMP** (High Pressure Pump)
Controls the operation (ON/OFF) of the HP pump and energizes a light indicating when the pump is operating. When only the HP pump is running, it signals the MCC to display the message "**HP PUMP ON**".

(9) **FLUSH**
Opens the automatic flush valve. Activates an internal time that will automatically run the LP and HP pumps for two minutes. Completion of each successful flush cycle will be recorded on the flush counter. After fifty flushes, the flush filter will signal the MCC to display a "**CHANGE FLUSH FILTER**" message.

(10) **RESET**
Pressing this pushbutton will either reset any counter displayed or stop all active system alarms and begin a system alarm self-test. This self-test verifies that all visual alarms (WQM and MCC) and audible alarms (for RO systems with the Remote Control Center) are fully operable.

(11) **HIGH SALINITY**
When the water monitor detects high saltwater content, a signal is sent to the MCC and the message "**CHECK PRODUCT WATER**" is displayed. Additionally, the MCC illuminates the "**HIGH SALINITY**" light.

(12) **CHECK UNIT**
The MCC will send a signal to the RCC when its internal counters activate any of the following alarms: Check Oil, Change Flush Filter or Clean Membranes. This, in turn activates the local "Check Unit" light and audible alarm at the RCC.

(13) **LOW PRESSURE**
When the system pressure switch detects a low pressure condition, a signal is sent to the MCC (and sends a signal to the RCC) and the message "CHECK FILTRATION" is displayed (on the MCC). Additionally, the "Low Pressure" light on the MCC and RCC illuminates and along with the audible alarm on the RCC.

(14) **MUTE/TEMP**
During an alarm, pressing this pushbutton on the RCC will silence the audible alarm. If not, it will display raw water temperature.

NOTE: **DO NOT be alarmed, if the salinity sensor displays a single numerical digit of 1. The water quality monitor is TEMPORARILY unreadable, until the saltwater content decreases. The display of 1 indicates the salinity of the water exceeded the detectable range for salinity of the water quality monitor.**

The Water Quality Monitor has a salinity detection range of zero ppm to 1999 ppm (0-1999 ppm).

NOTE: **The automatic display feature is intended to provide general guidance concerning membrane cleaning frequency only. Actual membrane cleaning frequency will vary in response to changes in the seawater conditions. Refer to Section 3.4 for specific information regarding how to determine actual cleaning frequencies.**

MESSAGE CENTER DISPLAY	ACTION
STANDBY MODE	Unit is in preparation for use
LP PUMP ONLY	Low Pressure Boost Pump running (**only**)
HP PUMP ONLY	High Pressure pump running (**only**) NO LP PUMP running
RO MODE	**BOTH** low and high pressure pumps **OPERATING**.
FLUSH	Perform Freshwater Flush
0>>>>>>>>>>>>> 2	Automatic timer countdown of Freshwater Flush
CHECK PRODUCT WATER	High salt content
CHANGE HP PUMP OIL	Replace oil after each 500 hours of use*
CLEAN MEMBRANES	Clean membranes every 2000 hours of use**
CHANGE FLUSH FILTER	Replace filter after every 50 Freshwater flushes***

Table 3.3: Master Control Center - Message Center Displays.

* **Oil Changes**:
The first oil change required, is after the first 50 hours of use on the RO unit.

The Master Control Center continuously monitors and records the total operated hours of the high pressure pump and will automatically indicate when the pump needs an oil change. Pressing the ***RESET*** pushbutton will reset this counter Also, the MCC illuminates the "**CHECK UNIT**" light.

** **Membrane Cleaning**:
The MCC also illuminates the "**CHECK UNIT**" light when the message is displayed. This feature is an indication only to clean membranes depending on the temperature-corrected product flow. For more information please refer to **Section 5.0: MAINTENANCE**.

The MCC continuously monitors and records the time used by the membranes and will automatically indicate when they need cleaning. Pressing the ***RESET*** pushbutton will reset this counter.

*** **Change Flush Filter:**
The MCC continuously monitors and records the number of freshwater flush cycles performed. After 50 flushes, the flush filter will signal the MCC displaying "**CHANGE FLUSH FILTER**" message. Pressing the ***RESET*** pushbutton will reset this counter. Also, the MCC illuminates the "**CHECK UNIT**" light.

4.0 OPERATION

4.1 TO START THE SQUIRT (SPW/MPW) AND STOWAWAY (STW) UNITS

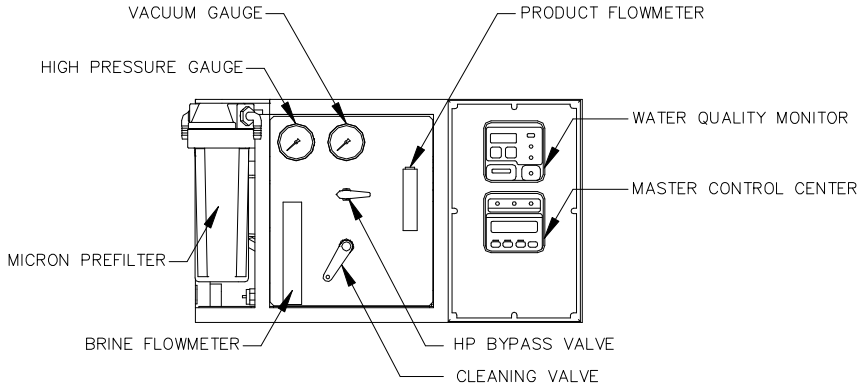


Figure 49: SQUIRT (SPW) - Instrument Detail

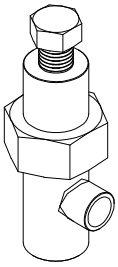


Figure 50: Pressure Regulator Valve

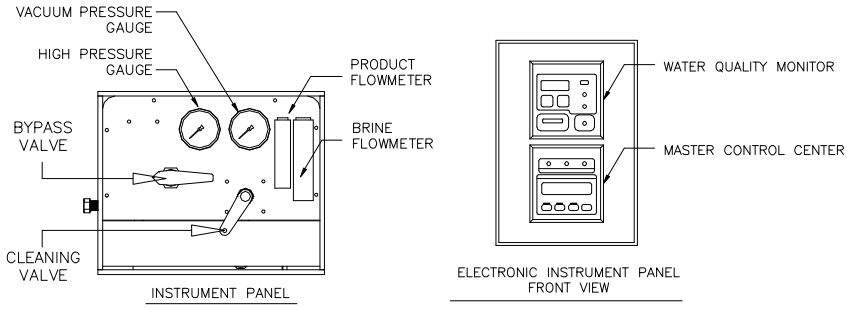


Figure 51: Squirt MODULAR (MPW) - Instrument Detail

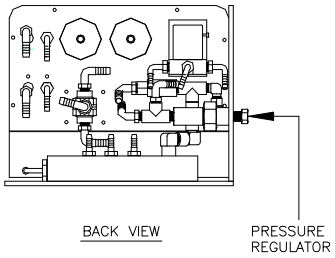


Figure 52: Pressure Regulator Location

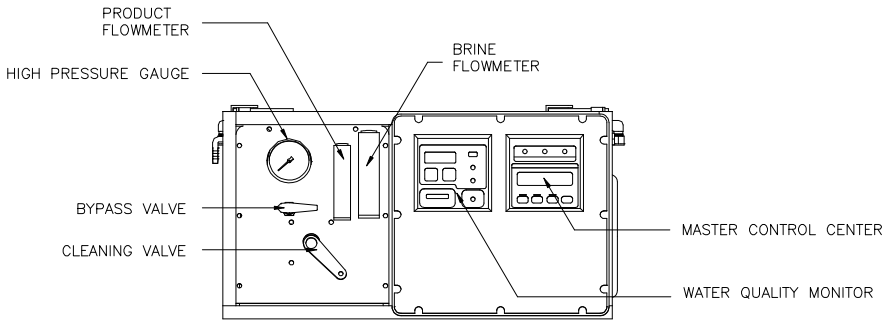


Figure 53: STOWAWAY (STW) - Instrument Detail

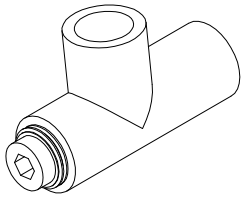


Figure 54: STOWAWAY Pressure Regulator

Step 1: Verify all power switches and power sources are in the ***OFF*** position.

Step 2: **For Units with Manual Freshwater Flush Valve Assembly:**
Refer to instrument details in Figures 49-54. Turn High Pressure Bypass Valve (Black Valve) to ***CLEANING POSITION***. This procedure allows release of the high pressure air trapped within the system. Verify the Cleaning Valve (Gray Valve) is positioned to ***NORMAL*** discharge. Also check the gray Freshwater Flush Valve is positioned for seawater intake, **NOT** freshwater.

For Units with Automatic Freshwater Flush Assembly:
Refer to instrument details in Figures 49-54. Turn High Pressure Bypass Valve (Black Valve) to ***CLEANING POSITION***. This procedure allows release of the high pressure air trapped within the system. Verify the Cleaning Valve (Gray Valve) is positioned to ***NORMAL*** discharge.

⚠ CAUTION **FAILURE TO OPEN THE HIGH PRESSURE BYPASS VALVE, WHICH IS REQUIRED TO RELEASE ANY TRAPPED AIR, COULD RESULT IN HYDRAULIC SHOCK TO THE SYSTEM.**

Step 3: Verify the seawater intake is open at the through-hull. This allows the feed seawater to flow into the unit. Start-up time can be expedited by filling the pre-filter housing with non-chlorinated freshwater (if available) before the RO unit is turned on.

Step 4: Switch ***ON*** the breaker at the main breaker panel to power up the unit.

Step 5: Start the Low Pressure Boost Pump by pressing the ***LP PUMP*** pushbutton located on the Master Control Center (or on the Remote Control Center).

Step 6: Start the High Pressure Pump by pressing the ***HP PUMP*** pushbutton located on the Master Control Center (or on the Remote Control Center).

Step 7: Upon start-up inspect all plumbing connections in the unit for leakage. Varying temperatures during shipment may cause plumbing connections to seep when starting the RO unit for the first time. Secure the unit and repair any leaks before proceeding. Once leaks are repaired, open the seawater source and restart the unit.

Step 8: Observe the Brine Flowmeter, to ensuring all air and bubbles exited the RO system prior to proceeding to next step.

Step 9: Gradually turn the High Pressure Bypass Valve (Black Valve) to ***NORMAL/RO*** position. The pressure gauge should rise steadily to a reading of 800 psi.

NOTE: When the High Pressure Bypass valve is closed, the salinity of the initial permeate produced will be relatively high and will probably activate the salinity alarm, do not be worried. Salinity should reduce in 3 to 5 minutes.

Step 10: Observe the system pressure on the High Pressure Gauge. During RO production, the indicated pressure should be at 800 psi. If the pressure reading is not at 800 psi, adjust the nut of the back pressure regulator valve (Refer to Figures 50 or 54) using a wrench or hex key, until the reading reaches 800 psi.

NOTE: If the RO unit is used for other than seawater purification (in freshwater or brackish water applications), reduce pressure as necessary to achieve product flow no greater than 120% of design flow to avoid membrane damage.

⚠ WARNING **RO high pressure production should NEVER EXCEED 950 psi, doing so risks damage to RO unit, VOIDING factory warranty and may also risk personal injury.**

NOTE: At initial start-up of RO unit, PRESS *DUMP* on the Water Quality Monitor to keep the product water diverted from the water storage tank. IF the unit is filled with preservative storage solution, water must be kept running AT LEAST 30 MINUTES to clear preservative solution from system.

Step 11: Check the RO unit for water leakage periodically at the initial start-up. Observe Product Flow meter. Record the product flow after 48 hours of operation (use the sample log sheet provided in Table 5.4).

NOTE: For Remote Control Operation:
The initial start-up of the RO unit must be followed FIRST prior to use of remote. Once initial start-up steps are performed, the necessary valve (HP Bypass and Freshwater Flush) positions would be set. Therefore the RO unit may now be started (or stopped) via the remote control panel for steps 5-6.

4.2 TO SHUT DOWN UNIT

Step 1: As the RO unit operates, turn the High Pressure Bypass Valve (Black Valve) to ***CLEANING POSITION***. This will release the high pressure and air trapped within the RO system.

NOTE: For the Remote Control Operation: The HP Bypass Valve may be left in the RO position (FULL CLOCKWISE) during shutdown. STEP #1 would be OMITTED.

Master Control Center (or via Remote Control Center)

Step 2: Press the ***HP PUMP*** pushbutton to stop the High Pressure Pump.

Master Control Center (or via Remote Control Center)

Step 3: Press the ***LP PUMP*** pushbutton to stop the Low Pressure Pump.

Step 4: Then turn switch ***OFF*** on your breaker at the main breaker panel.

The RO unit may be left in this "stand by" condition with the seawater for up to seven days or three days in hot, tropical climates. If the RO unit will be out of service for extended time periods, please refer to the Maintenance section of this manual.

Step 5: To restart the **SQUIRT or STOWAWAY**, refer to instructions in **Section 4.1: TO START THE SQUIRT (SPW/MPW) AND STOWAWAY (STW) UNITS**

5.0 MAINTENANCE

The service life of most system equipment is directly related to the raw water inlet conditions. Improper maintenance will also significantly reduce the life expectancy of the major unit components (such as the membranes, filters and pumps) as well as the reliability of the unit as a whole. Under normal conditions, and with proper maintenance, a reverse osmosis membrane (which is the major consumable item) should have an effective service life somewhere between 4 and 6 years.

NOTE: **The RO unit must be cleaned when product water output drops below 5 GPH or when production output drops by 20%.**

	Daily	Weekly	Monthly	Quarterly	Semi-Annually	Annually	As Required	Labor Hours (approximate)
Clean/inspect micron prefilter			•					0.5
Replace filter(s)*				•				0.5
Clean membranes							•	2.0
Replace Membranes							•	1.0
Check pump oil level			•					0.1
Change pump oil**						•		0.5
Lubricate pump motor						•		0.5

Table 5.1: Maintenance Task Chart.

* VMT prefilter cartridges can be rinsed with freshwater and be reused up to 3 times.

** Change pump oil after first **50** hours of RO use. After the first oil change at 50 hours, change the pump oil every **500** hours thereafter or once annually which ever interval comes first.

FRESHWATER FLUSH / SHORT TERM STORAGE

Ideally, the Squirt and the Stowaway performs optimally when the RO unit is used regularly. The likelihood of bacterial and biological growth in the membranes increases, when stagnant seawater (in extended periods) is in contact with the membranes. A freshwater flush procedure is necessary to prevent clogging and growth of organic contaminants in the RO system and its membranes. This method pushes out older stagnant seawater (saltwater) out of the membranes and replacing it with freshwater (non-saltwater), leaving less chance of fouling the membranes. The freshwater flush procedure should be used when the unit will be placed idle or in “stand by” condition for more than several days **OR** idle for three days in hot, tropical climates. Although they do not attack the membranes or other system components directly, high concentrations of biological matter can block enough of the product water channels to cause a reduction of as much as 40% of the total system capacity.

⚠ CAUTION **PERFORM A FRESHWATER FLUSH TO THE RO UNIT WITH NON-CHLORINATED FRESH WATER ONLY. EXPOSING THE MEMBRANES TO CHLORINATED WATER WILL CAUSE IRREVERSIBLE DAMAGE AND VOID THE RO UNIT WARRANTY. THE FRESHWATER FLUSH SYSTEM USES A CARBON FILTER INLINE BEFORE SYSTEM TO CONSUME THE CHLORINE THAT MAY BE PRESENT FROM THE DOCK WATER.**

5.1 TO FLUSH THE SQUIRT (SPW/MPW) AND STOWAWAY (STW) UNITS

Step 1: Verify all power switches and power sources are turned ***OFF*****.**

Step 2: **For Units with Manual Freshwater Flush Valve Assembly:**
Turn ***ON*** your water pressure and watermaker breakers on main electrical panel. Turn the High Pressure Bypass Valve to ***CLEANING*** (ensuring zero pressure in system). Verify the gray Cleaning Valve is positioned to ***NORMAL/REVERSE OSMOSIS*** position.

For Units with Automatic Freshwater Flush Valve Assembly:
Verify the gray Cleaning Valve is positioned to ***NORMAL/REVERSE OSMOSIS*** position. Then go to Step 4.

Step 3: **For Units with Manual Freshwater Flush Valve Assembly:**
Turn the Freshwater Flush Valve to ***FRESHWATER*** position.

Step 4: Turn ***ON*** the breaker at the main breaker panel.

Step 5: Verify the freshwater supply pressure on the Vacuum/Pressure Gauge, does not exceed 35 psi. SPW/MPW models refer to Figures 49 or 51. STW refer to Figure 55.

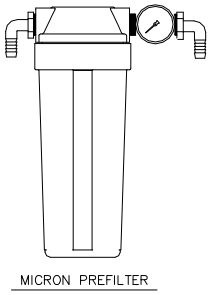


Figure 55: STW - Vacuum Pressure Gauge Attached to Prefilter Assembly.

Step 6: Press the ***FLUSH*** pushbutton located on the Master Control Center on the electronic instrument panel (or the Remote Control Center, if equipped). This will automatically begin the freshwater flush cycle within the RO system. The electronic flush will automatically start the Low Pressure Boost Pump, then the High Pressure Pump, and begin the flushing process, for a period of two minutes.

After flushing the unit for two minutes, the High Pressure Pump and Low Pressure Pump will shutdown respectively. A confirmation of completion of the Freshwater Flush is displayed on the Master Control Center, reading STANDBY.

Step 7: Turn ***OFF*** the breaker at the main breaker panel.

Step 8: **For Units with Manual Freshwater Flush Valve Assembly:**
Turn the Freshwater Flush Valve to ***SEAWATER*** position. Leave RO unit in standing condition, for up to three weeks. Then reflush or preserve.

For Units with Automatic Freshwater Flush Valve Assembly:
Leave RO unit in standing condition, for up to three weeks. Then reflush or preserve.

Step 9: To restart the **SQUIRT or STOWAWAY**, refer to instructions in **Section 4.1: TO START THE SQUIRT (SPW/MPW) AND STOWAWAY (STW) UNITS**.

5.2 MEMBRANE CLEANING

The membrane elements require occasional service; it is recommended to clean the membranes only when dirty. Basic procedure for all cleaning and preservative treatments are similar- a specific chemical solution is circulated through the system for a pre-determined length of time.

NOTE: All cleaning and preservation procedures should be performed with NON-CHLORINATED freshwater to optimize performance of cleaning process.

NOTE: Allow your unit's product water to run with product to DUMP for the first 30 minutes after cleaning or upon startup after preservation.

Description	Cartridge Form	Powder Form
Cleaning Chemical #1	1 Cartridge (Blue Stripe)	10 TBSP
Cleaning Chemical #2	1 Cartridge (Red Stripe)	10 TBSP
Preservative Chemical #3	1 Cartridge (Green Stripe)	3 TBSP

Table 5.2: Chemical Requirements

5.3 CLEANING CHEMICALS

⚠ CAUTION **CLEANING CHEMICAL #1 IS AN ALKALINE DETERGENT, USED TO REMOVE OIL, GREASE, BIOLOGICAL MATTER, AND GRIME FROM THE SURFACE OF THE RO MEMBRANES. SEE WARNING LABEL ON SIDE OF PACKAGE AND OBSERVE ALL SAFETY PRECAUTIONS ON LABEL.**

⚠ CAUTION **CLEANING CHEMICAL #2 IS AN ACID, A MINERAL SCALE REMOVER. SEE WARNING LABEL ON SIDE OF PACKAGE AND OBSERVE ALL SAFETY PRECAUTIONS ON LABEL.**

⚠ WARNING **THE USE OF CHEMICALS OR CLEANING METHODS OTHER THAN THOSE OUTLINED IN THIS MANUAL WILL VOID THE RO UNIT WARRANTY. NON-IONIC SURFACTANTS USED FOR MEMBRANE CLEANING OR ANY OTHER CHEMICALS NOT APPROVED IN WRITING BY VILLAGE MARINE TEC., WILL VOID THE RO UNIT WARRANTY.**

5.4 WHEN TO CLEAN

Chemically clean the RO, when product water output drops below 80% of original production. The frequency of this occurring varies greatly upon feed water. Membrane fouling will occur with normal use.

NOTE: Product water output depends feedwater temperature, pressure and salinity. Product water output reductions from these factors are normal and may not indicate need for membrane cleaning.

For **POWDER** format chemical cleaning: Follow the procedures on pages 38-39 to clean the RO elements.
For **CARTRIDGE** format chemical cleaning: Follow the procedures on page 40 to clean the RO elements.

STEPS FOR CHEMICAL CLEANING #1: HIGH pH CLEANER

Step 1: Freshwater Flush the watermaker so it is filled with fresh water, **NOT** seawater. To flush the SPW, MPW, or STW, refer to instructions in **Section 5.1: TO FLUSH THE SQUIRT (SPW/MPW) AND STOWAWAY (STW) UNITS**.

⚠ CAUTION **FLUSH THE UNIT WITH NON-CHLORINATED FRESHWATER ONLY. EXPOSING MEMBRANES TO CHLORINATED WATER MAY CAUSE IRREVERSIBLE DAMAGE AND VOID RO UNIT WARRANTY.**

Step 2a: Dissolve the appropriate amount of Cleaning Chemical #1 (see Table 5.2) in **non-chlorinated** water of prefilter capacity, to obtain a pH level of 11. Use ***CAUTION*** as a pH level above 12 may damage membranes. Verify the chemical is completely dissolved (use warm water if necessary).

Step 2b: Measure the pH level of the sample using test kit #90-0135. If the pH is **LESS** than 11, add Cleaning Chemical #1 to raise pH level. Add Cleaning Chemical #2 to lower pH level. Repeat 2b until pH is 11.

Step 3: Verify that the (black) High Pressure Bypass Valve is in the ***CLEANING*** (open) position.

Step 4: Place the (gray) cleaning valve in the ***CLEANING*** position.

Step 5: Remove the prefilter element from the prefilter tank and replace the micron filter with one dedicated cleaning filter (5 micron). Leave the carbon flush filter in place. A dedicated cleaning prefilter should be used to prevent fouling of the operational prefilters. When the process is complete the dedicated cleaning filter can be cleaned and set aside until the next membrane cleaning is required.

Step 6: Pour the chemical solution made from Step #2 into the prefilter tank. Reinstall the prefilter housing.

Step 7: Start the Low Pressure Boost Pump by pressing the ***LP PUMP*** pushbutton located on the Master Control Center (or on the Remote Control Center).

Step 8: Start the High Pressure Pump by pressing the ***HP PUMP*** pushbutton located on the Master Control Center panel (or on the Remote Control Center). If pressure is not greater than 0 psi, recheck the valve positions from Step #1.

Step 9: After circulating the chemical solution for 3 minutes, shutdown the ***HP PUMP*** and ***LP PUMP***, respectively.

a) Remove the prefilter housing and manually sample the filter water. Measure the pH level of the sample using test kit #90-0135. If pH level is reached, reattach prefilter housing and go to Step #10. If pH level is not attained, follow Step #2b to reach desired pH level and then go to Step #9b.

b) Once a pH level of 11 is achieved, re-secure the prefilter housing. Start the ***LP PUMP*** and ***HP PUMP*** respectively and allow the cleaning solution to circulate for an additional 30-40 minutes.

After 30-40 minutes, shutdown the ***HP PUMP*** and ***LP PUMP***, respectively.

Step 10: Place the (gray) cleaning valve in ***NORMAL*** flow position.

Step 11: Open the raw water supply (seacock) to the RO unit.

Step 12: Start the ***LP PUMP*** and ***HP PUMP*** respectively. Allow both pumps to run for 5 additional minutes to flush the chemical solution from the RO.

Step 13: After 5 minutes, shutdown the ***HP PUMP*** and ***LP PUMP***, respectively.

Step 14: Move valves back to cleaning positions.

STEPS FOR CHEMICAL CLEANING #2: LOW pH CLEANER

Step 15: Freshwater Flush the watermaker so it is filled with fresh water, **NOT** seawater. To flush the SPW, MPW, and STW, refer to instructions in **Section 5.1: TO FLUSH THE SQUIRT (SPW/MPW) AND STOWAWAY (STW) UNITS**.

⚠ CAUTION **FLUSH THE UNIT WITH NON-CHLORINATED FRESHWATER ONLY. EXPOSING MEMBRANES TO CHLORINATED WATER MAY CAUSE IRREVERSIBLE DAMAGE AND VOID RO UNIT WARRANTY.**

Step 16a: Dissolve the appropriate amount of Cleaning Chemical #2 (see Table 5.2) in **non-chlorinated** of prefilter capacity to obtain a pH level of 3. Verify the chemical is completely dissolved (use warm water if necessary).

Step 16b: Measure the pH level of the sample using test kit #90-0135. If the pH is **GREATER** than 3, add Cleaning Chemical #2 to lower the pH level. Add Cleaning Chemical #1 to raise the pH level. Repeat 2b until pH is about or less than 3.

Step 17: Verify that the (black) High Pressure Bypass Valve is in the ***CLEANING*** open position.

Step 18: Place the (gray) cleaning valve in the ***CLEANING*** position.

Step 19: Remove the prefilter element from the prefilter tank and replace the micron filter with one dedicated cleaning filter (5 micron). Leave the carbon flush filter in place. A dedicated cleaning prefilter should be used to prevent fouling of the operational prefilters. When the process is complete the dedicated cleaning filter can be cleaned and set aside until the next membrane cleaning is required.

Step 20: Pour the chemical solution made from Step #16 into the prefilter tank. Reinstall the prefilter housing.

Step 21: Start the Low Pressure Boost Pump by pressing the ***LP PUMP*** pushbutton located on the Master Control Center (or on the Remote Control Center).

Step 22: Start the High Pressure Pump by pressing the ***HP PUMP*** pushbutton located on the Master Control Center panel (or on the Remote Control Center). If pressure is not greater than 0 psi, recheck the valve positions from Step #1.

Step 23: After circulating the chemical solution for 3 minutes, shutdown the ***HP PUMP*** and ***LP PUMP***, respectively.

a) Remove the prefilter housings and manually sample the filter water. Measure the pH level of the sample using test kit #90-0135. If pH level is reached, reattach prefilter housing and go to Step #24. If pH level is not attained, follow Step #16b to reach desired pH level and then go to Step #23b.

b) Once a ph level of 3 is achieved, re-secure the prefilter housing. Start the ***LP PUMP*** and ***HP PUMP*** respectively and allow the cleaning solution to circulate for an additional 30-40 minutes.

After 30-40 minutes, shutdown the ***HP PUMP*** and ***LP PUMP***, respectively.

Step 24: Place the (gray) cleaning valve in ***NORMAL*** flow position.

Step 25: Open the raw water supply (seacock) to the RO unit.

Step 26: Start the ***LP PUMP*** and ***HP PUMP*** respectively. Allow both pumps to run for 5 additional minutes to flush the chemical solution from the RO.

Step 27: After 5 minutes, shutdown the ***HP PUMP*** and ***LP PUMP***, respectively and close the raw water supply.

Step 28: Remove and replace the prefilter with the operational filter. Store the cleaning prefilter for future use. Move valves to normal operational positions as in **Sections 4.1: TO START THE SQUIRT (SPW/MPW) AND STOWAWAY (STW) UNITS.**

5.5 LONG TERM STORAGE / PRESERVATION PROCEDURE

During periods when the RO unit is to be shut down for an extended period of time, it is necessary to re-flush the unit every three weeks OR to circulate a preservative solution through the membrane to prevent the growth of biological organisms. Use the following procedure to preserve the RO elements:

NOTE: You should allow your unit's product water to run to *DUMP* for the first 30 minutes after cleaning or upon startup after preservation.

5.6 STEPS FOR PRESERVATION CHEMICAL #3

Step 1: Freshwater Flush the watermaker so it is filled with fresh water, **NOT** seawater. To flush the SPW, MPW, or STW, refer to instructions in **Section 5.1: TO FLUSH THE SQUIRT (SPW/MPW) AND STOWAWAY (STW) UNITS**.

⚠ **CAUTION** **FLUSH THE UNIT WITH NON-CHLORINATED FRESHWATER ONLY. EXPOSING MEMBRANES TO CHLORINATED WATER MAY CAUSE IRREVERSIBLE DAMAGE AND VOID RO UNIT WARRANTY.**

Step 2: Dissolve the appropriate amount of Preservative Chemical #3 (see Table 5.2) in **non-chlorinated** water (enough to fill the micron filter bowls). Verify the chemical is completely dissolved (use warm water if necessary).

⚠ **CAUTION** **PRESERVATIVE CHEMICAL #3 IS A FOOD GRADE PRESERVATIVE. SEE WARNING LABEL ON SIDE OF PACKAGE AND ADHERE TO ALL SAFETY PRECAUTIONS ON LABEL.**

Step 3: Verify that the (black) High Pressure Bypass Valve is in the ***CLEANING*** open position.

Step 4: Place the (gray) cleaning valve in the ***CLEANING*** position.

Step 5: Remove the prefilter housing and pour in the preservative solution prepared in Step #3.

Step 6: Start the Low Pressure Boost Pump by pressing the ***LP PUMP*** pushbutton located on the Master Control Center (or on the Remote Control Center).

Step 7: Start the High Pressure Pump by pressing the ***HP PUMP*** pushbutton located on the Master Control Center panel (or on the Remote Control Center). Verify the Vacuum Pressure Gauge reads more than zero (0 psi). If pressure is not greater than 0 psi, recheck the valve positions from Step #1.

Step 8: Allow the RO to run for than 10 minutes to allow the chemical solution to circulate through the RO.

Step 9: Shutdown the ***HP PUMP*** and ***LP PUMP***, respectively.

Step 10: The system is properly conditioned and may be left idle for an extended period of time. This preservation procedure should be repeated at least every 4 months during the shutdown. In colder climates the interval between preservation cycles may be extended to 6 months. Remember to flush out old preservative before re-preserving.

Step 11: To restart the **SQUIRT or STOWAWAY**, refer to instructions in **Sections 4.1: TO START THE SQUIRT (SPW/MPW) AND STOWAWAY (STW) UNITS.**

NOTE: For resuming normal RO operation (unpreserving or "unpickling"), install a FIVE MICRON filter into prefilter housing and fill it with NON-CHLORINATED WATER. Begin system Start Up Procedures by referring to Sections 4.1: TO START THE SQUIRT (SPW/MPW) AND STOWAWAY (STW) UNITS.

*** IF RO unit storage time is to exceed FOUR months, then it is NECESSARY to FLUSH (PUSH OUT) the existing chemical out of the unit and represerve at EVERY FOUR MONTH INTERVAL.**

STEPS FOR CLEANING CHEMICALS #1, #2, AND #3 (CARTRIDGE FORM)

Single Use Cleaning Cartridges: Chemical #1 and Chemical #2	Single Use Preservative Cartridge: Chemical #3
Step 1. Prior to cleaning the RO, complete a freshwater flush to the system. **(REFER TO SECTION 5.1)**	Step 1. Prior to preserving the RO, complete a freshwater flush to the system. **(REFER TO SECTION 5.1)**
Step 2. Remove 5 micron prefilter from housing.	Step 2. Remove 5 micron prefilter from housing.
Step 3. Place cleaning filter Chemical # 1 (Blue Stripe) into prefilter housing and fill with unchlorinated water. Screw housing back into place.	Step 3. Place preservation filter Chemical # 3 (Green Stripe) into prefilter housing and fill with unchlorinated water. Screw housing back into
Step 4. **ALL UNITS (PRODUCED AFTER SEPTEMBER 1, 2003):** Place High Pressure Bypass Valve into Cleaning position. **MODULAR UNITS (PRODUCED PRIOR SEPTEMBER 1, 2003):** Open High Pressure Regulator, adjusting nut counter-clockwise until loose.	Step 4. **ALL UNITS (PRODUCED AFTER SEPTEMBER 1, 2003):** Place High Pressure Bypass Valve into Cleaning position. **MODULAR UNITS (PRODUCED PRIOR SEPTEMBER 1, 2003):** Open High Pressure Regulator, adjusting nut counter-clockwise until loose.
Step 5. Turn cleaning valve to clean/recirculate position.	Step 5. Turn cleaning valve to clean/recirculate position.
Step 6. Start RO unit and let unit run for 30 minutes, in the recircluate mode.	Step 6. Start RO unit and let unit run for 30 minutes, in the recircluate mode.
Step 7. Turn Unit OFF after running for 30 minutes; Place cleaning valve to overboard position; Remove the cleaning chemical cartridge from the prefilter housing; Install a 5 micron prefilter cartridge in housing and resecure housing place.	Step 7. Turn Unit OFF after running for 30 minutes.
Step 8. Open the inlet seacock and flush with water overboard for 5 minutes at 0 psi.	Step 8. Leave all valves in position they are now in.
Step 9. If necessary to use Cleaning Chemical #2 (Red Stripe) return to Step 1 to follow steps used for Chemical Cleaning #1.	Step 9. Remove and discard Chemical Cartridge #3 from prefilter housing. Then secure the prefilter housing empty with no micron filter.
Step 10. Remove the 5 micron prefilter (not necessary to discard, designate that as the cleaning prefilter for next use at Step 7) from the prefilter housing. Then secure the prefilter housing with a NEW 5 micron filter.	Step 10. Unit is now preserved.
Step 11. Return RO to Normal Conditions.	
Step 12. Record production flow rate before and after cleaning to determine effectiveness.	

NOTE: **For resuming normal RO operation (unpreserving or "unpickling"), install a FIVE MICRON filter into prefilter housing and fill it with UNCHLORINATED WATER. Begin system Start Up Procedures by referring to Section 4.1.**

NOTE: **IF RO unit storage time is to exceed four months, then it is NECESSARY to FLUSH (PUSH OUT) the existing chemical out of the unit and represerve at EVERY FOUR MONTH INTERVAL.**

5.7 OIL CHANGE PROCEDURE

An oil change is recommended after the first 50 hours of RO use. Subsequent oil changes are to be performed every 500-hour intervals OR changed annually. Change oil any time moisture is detected or if oil is cloudy. For additional pump information, refer to **Section 12.0: MANUFACTURER'S LITERATURE** in back of this manual.

⚠ CAUTION

DO NOT RUN PUMP WITHOUT OIL IN THE CRANKCASE.

NOTE: **Prior to the oil change, it MAY facilitate the oil replacement process by running the RO unit to heat the oil. Heating the oil reduces the viscosity allowing it to be more fluid to travel through the pump.**

THE SQUIRT AND SQUIRT MODULAR UNIT OIL CHANGE PROCEDURE

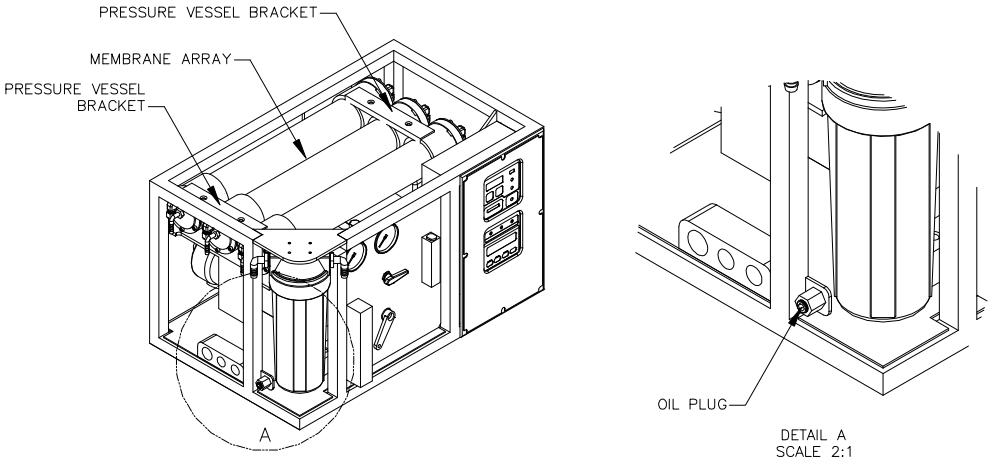


Figure 56: SQUIRT Oil Drain Location – Isometric View.

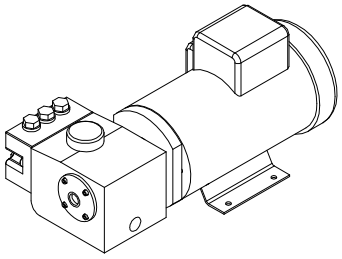


Figure 57: Squirt MODULAR HP Pump and Motor.

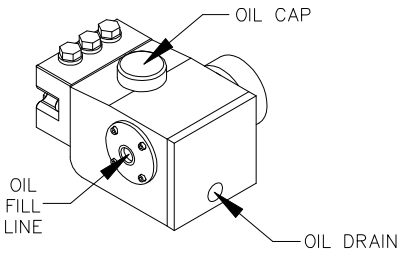


Figure 58: High Pressure Pump – Isometric View.

Step 1: Turn off all power sources and switches.

Step 2: Before changing the oil, obtain a container (i.e. a small bucket, bottle, or catch basin) to collect the oil drainage.

Step 3: **For SQUIRT Units**:
Disconnection of hoses or fittings **may** be necessary. Mark and record all hose locations attached to the pressure vessel assemblies for reference. Also, it **may** be necessary to remove the pressure vessel brackets (Refer to Figure 42) of the Squirt and tilt the membrane aside to gain access to the pump's oil cap opening.

Remove the oil plug (Refer to Figure 42) and direct the oil plug hose to a catch basin or bottle. Allow the oil to drain empty. Clean out any residue that may have collected in the pump.

For Squirt MODULAR Units:
The Squirt Modular does not have an oil plug. Instead, place a catch basin/container beneath the high pressure pump and remove the oil drain (Refer to Figure 44) stopper to allow the oil to empty from within the pump.

Step 4: Reconnect the oil plug or oil drain stopper. Then unscrew the oil cap and refill oil to fill line (Refer to Figure 44). Check for leaks and re-secure oil cap.

Step 5: **For SQUIRT Units (if Membrane Array is Disconnected)**:
Return the pressure vessels to original orientation and reassemble any hoses or fittings disconnected for the oil change.

Step 6: **For SQUIRT Units (if Membrane Array is Disconnected)**:
Re-secure the pressure vessel brackets.

THE STOWAWAY UNIT OIL CHANGE PROCEDURE

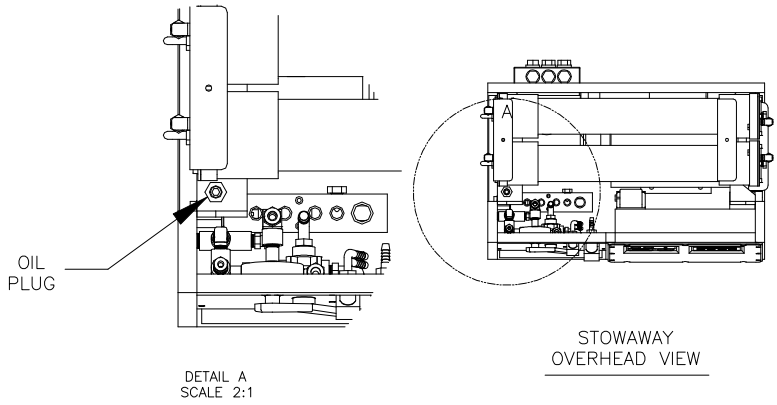


Figure 59: STOWAWAY Oil Plug – Overhead View.

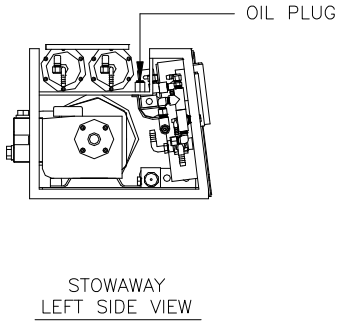


Figure 60: STOWAWAY Oil Plug – Side View.

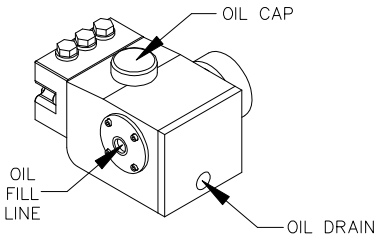


Figure 61: High Pressure Pump – Isometric View.

Step 1: Turn off all power sources and switches.

Step 2: Before changing the oil, obtain a container (i.e. a small bucket, bottle, or catch basin) to collect the oil drainage.

Step 3: Remove the oil plug (Refer to Figure 60) and direct the oil plug hose to a catch basin or bottle. Allow the oil to drain empty. Clean out any residue that may have collected in the pump.

Step 4: Reconnect the oil plug. Then unscrew the oil cap and refill oil to fill line (Refer to Figure 61). Check for leaks and re-secure oil cap.

5.8 RO MOTOR LUBRICATION

Location	Type
High Pressure Pump	Village Marine Tec. Pump Oil, P/N #85-0050
High Pressure Pump Motor	Chevron SRI Grease - NGLI 2 ExxonMobil PolyrexEM Grease Shell Oil Dolium R - NGLI 2 Texaco Premium RB
O-Rings and Gaskets	Glycerin or Silicone Lubricant

Table 5.2: Motor and HP Pump Lubrication Requirements.

Step 1: Locate the grease fittings on the motor (Refer to Figure 62). Use a clean cloth to wipe fittings clean.

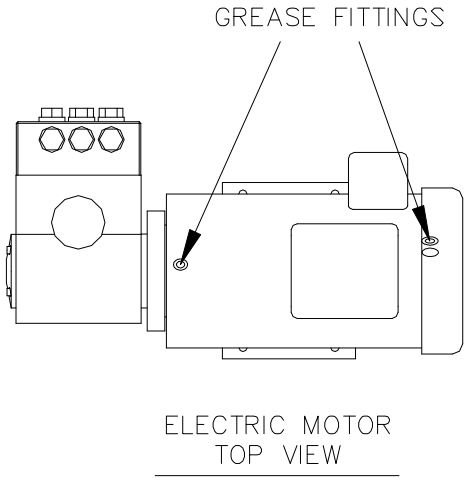


Figure 62: Electric Motor - Grease Fitting Locations.

Step 2: Remove filler and drain plugs. Free drain hole of any hard grease if present (use a piece of wire if necessary).

Step 3: Add 2-3 strokes of grease using a low pressure grease gun (see Table 5.2 for grease type).

Step 4: If the motor is equipped with a motor drain plug, start RO unit and let it run for approximately 20 minutes prior to replacing drain plug.

Step 5: Secure the RO unit, wipe off any of the drained grease and replace the fill and drain plugs, as required. The motor is now ready to resume operation.

5.9 CLEANING THE SALINITY PROBE

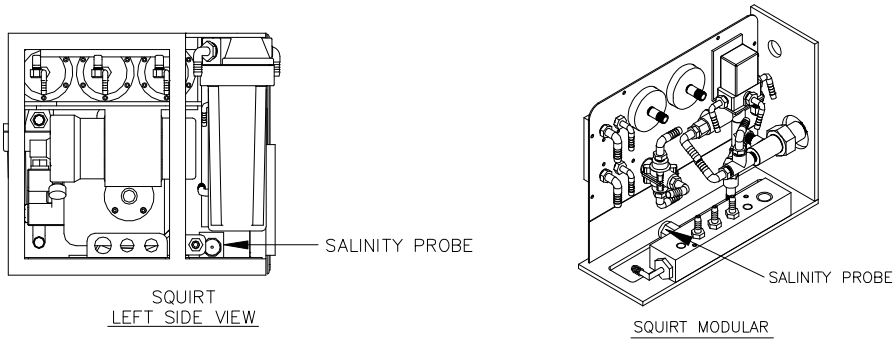


Figure 63: SQUIRT and Squirt MODULAR - Salinity Probe Locations.

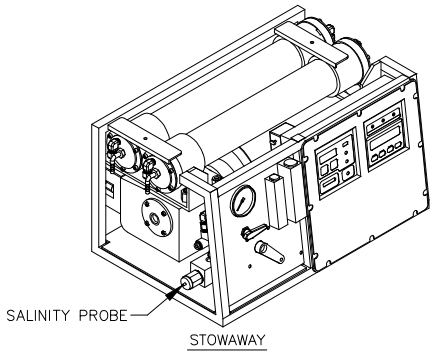


Figure 64: STOWAWAY – Salinity Probe Location.

Step 1: Unscrew the salinity probe from the manifold. Refer to Figures 63-64 for visible location of the probe.

Step 2: Clean the probe with a soft cloth and mild detergent. Continue to clean until the probe prong surfaces (Refer to Figure 65) are clear and bright. If required, gently scrub with emery paper (or known as wet-sand paper) or warm vinegar to aid in the removal of difficult scale and film deposits. Clean the salinity probe port of the manifold also.

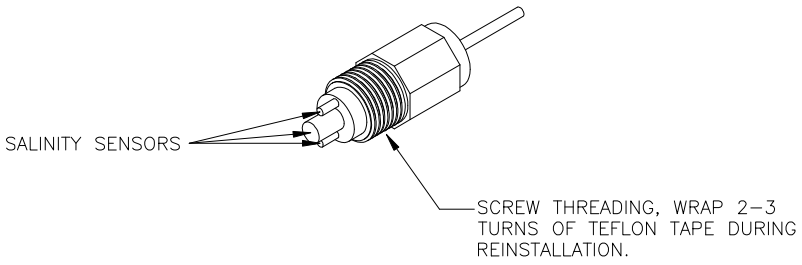


Figure 65: Salinity Probe – Isometric View.

NOTE: When cleaning the salinity probe, be careful NOT to force the salinity sensors out of alignment (Refer to Figure 65). Doing so may negatively affect its calibration.

Step 3: Clean any residual pipe sealant from the probe's screw threads and then rewrap it with Teflon tape (2-3 turns). Reinstall the probe in the manifold, carefully tighten the probe until taut. Do not force to over-tighten the probe into the manifold, as this may cause the probe body to crack.

Step 4: Start the RO and inspect for leaks around the manifold and salinity probe port.

Date	Total Hours	HP Pump Inlet Pressure	RO Array Pressure	Product Flow GPH	Brine Flow GPH	Prod water TDS, ppm	Water Temp, °C

Table 5.4: Sample Operational Log

6.0 MEMBRANE REPLACEMENT

6.1 PRESSURE VESSEL DISASSEMBLY

Step 1: Disconnect plumbing from pressure vessel for disassembly.

Step 2: Remove the six fasteners and cap ring holding each end plug with an allen wrench. Place a mark on each end plug to be removed, place a corresponding mark on each end collar. This will ensure proper orientation during assembly. Refer to Figure 6.2.

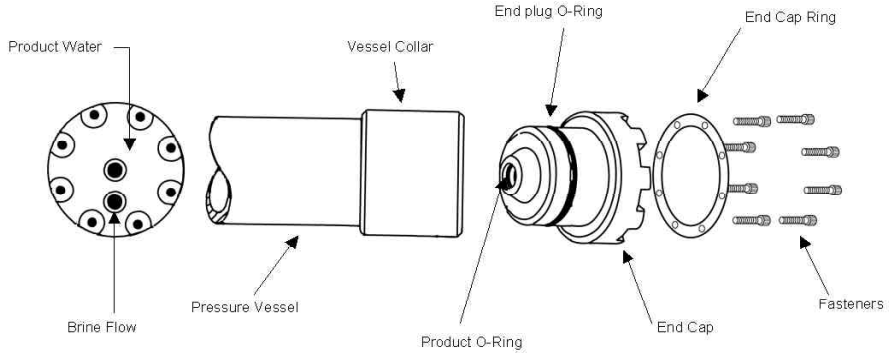


Figure 6.1 - Pressure Vessel End Plug Assembly Callout.

Step 3: Locate the screwdriver slots located on opposite ends of the pressure vessel end collar (Refer to Figure 6.1). Place an appropriate sized slot screwdriver in each slot. Twist both screwdrivers until the end plug breaks loose from the pressure vessel. The screwdrivers can now be placed between the end plug and collar. A prying motion on both sides of the end plug with the screwdrivers will quickly remove it. Use this procedure for both end caps.

Step 4: Note which end of the pressure vessel the brine seal is visible from. The brine seal is a black u-cup seal on the membrane outer diameter near one end (Refer to Figure 6.3). This is the feed end of the pressure vessel. When reinstalling the RO membrane the **brine seal must be located at the feed end of the pressure vessel.of the pressure vessel.**

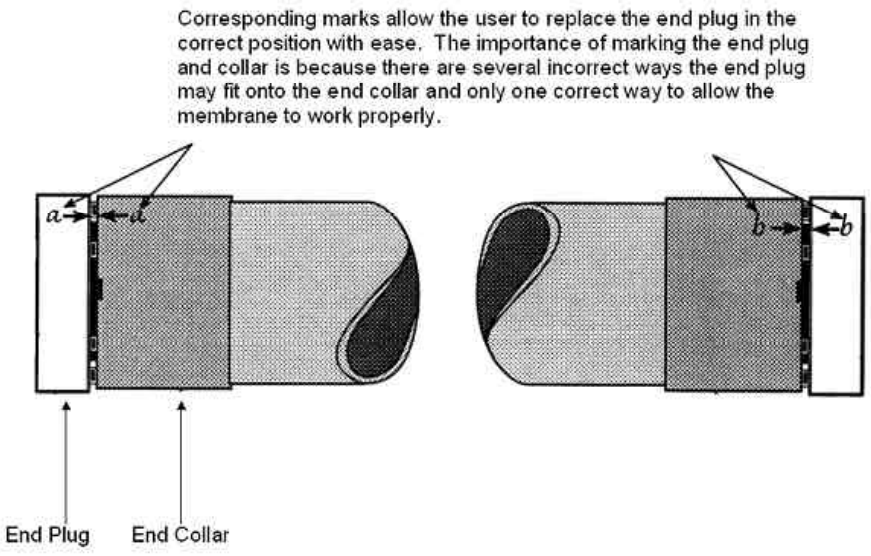

Corresponding marks allow the user to replace the end plug in the correct position with ease. The importance of marking the end plug and collar is because there are several incorrect ways the end plug may fit onto the end collar and only one correct way to allow the membrane to work properly.
a
a
b
b
End Plug
End Collar

Figure 6.2 – Membrane Corresponding Mark Placement.

Step 5. Once membrane is released from product O-Ring. Pull membrane from brine end until completely free of vessel.

⚠ CAUTION **NEVER FORCE A MEMBRANE OUT OF A PRESSURE VESSEL BY APPLYING PRESSURE ON THE PRODUCT WATER TUBE (CENTER TUBE), AS THIS WILL DAMAGE THE MEMBRANE. IF MEMBRANE IS DIFFICULT TO REMOVE, USE A 2" DIAMETER PLASTIC PIPE (PVC) TO APPLY PRESSURE ON THE PROTECTED END OF THE MEMBRANE.**

6.2 PRESSURE VESSEL ASSEMBLY

Step 1: Replace O-Rings if there is visible damage. Inspect all O-Rings; product O-Rings, end plug O-Rings, and Brine seal. The product water O-Rings are internal O-Rings, inside the center hole in the end cap. Refer to Figure 6.1.

Step 2: Clean all parts thoroughly.

Step 3: Lubricate O-Rings and entrances to pressure vessel with glycerin or silicone lubricant**. Locate discharge end of pressure vessel**. **Install discharge end plug** by lining up with the holes of the pressure vessel, paying attention to the reference mark. Position end cap ring and insert fasteners by hand.

⚠ CAUTION **NEVER USE ANY TYPE OF LUBRICANT CONTAINING OIL ADDITIVES. OIL CAN DAMAGE YOUR UNIT AND REDUCE MEMBRANES PERFORMANCE.**

Step 4: Lubricate brine seal and product water tubes of RO membrane with glycerin or silicone lubricant. Align the membrane so the end **without** the brine seal enters the feed end of the pressure vessel first. Slide membrane into pressure vessel until resistance is felt. Continue applying pressure until the product water tube sits into the end plug.

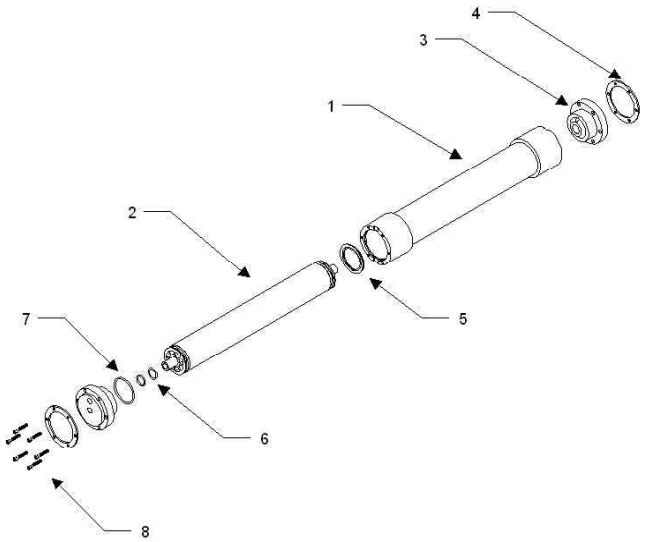
Step 5: Install the remaining end plug (align end plug holes with mounting studs properly), use the reference mark made in step 3 for correct assembly.

Step 6: Tighten the six fasteners for each end cap. Recommended that fasteners be torqued to 25 in-lbs.

Step 7: Reconnect plumbing to pressure vessel(s).

NOTE: Do not apply Teflon tape or sealant to SAE fittings such as those used on High Pressure assemblies and their adapters.

NOTE: For replacement parts call numbers, refer to Parts Reference section at the end of the manual and for additional information about the membranes and the pressure vessel, refer to the Manufacturer's Literature section at the back of this manual.X



Item	Description
1	Vessel - 2538
1	Vessel - 2519
2	Membrane - SW 2538
2	Membrane - SW 2519
3	End cap
4	End cap ring
5	Brine Seal
6	Product O-rings
7	End Plug O-ring
8	Fasteners

Figure 6.3 - Exploded View of Pressure Vessel with Membrane.

7.0 FREEZE PROTECTION

There is a high probability of damaging your RO by exposing it to severe cold or icy conditions. Therefore protecting your RO against freeze damage is recommended. The following information provides steps towards safeguarding your RO and extending its plumbing life against freezing temperatures.

⚠ WARNING **DO NOT USE ETHYLENE GLYCOL (FOUND IN AUTOMOTIVE ANTIFREEZE PRODUCTS) TOWARDS FREEZE PROTECTING YOUR RO. ETHYLENE GLYCOL IS A TOXIC SUBSTANCE AND MUST NOT BE INGESTED NOR COME INTO CONTACT WITH YOUR RO SYSTEM.**

⚠ WARNING **USE ONLY FOOD GRADE NON-TOXIC PROPYLENE GLYCOL. DO NOT USE PROPYLENE GLYCOL BLENDED WITH SUPPLEMENTARY ADDITIVES.**

FREEZE PROTECT YOUR RO UNIT

Adhere to the packaging label directions of the food grade propylene glycol, for the amount of propylene glycol to be mixed based on the level of temperature protection required. Use non-chlorinated freshwater and make up sufficient solution to fill your prefilter housing.

Step 1: Close inlet seacock and flush unit with fresh water. Refer to **Sections 5.1: TO FLUSH THE SQUIRT (SPW/MPW) AND STOWAWAY (STW) UNITS**

Step 2: Remove the micron filter from the prefilter housing and empty the prefilter housing.

Step 3: Pour the winterizing solution into filter housing and reattach the prefilter canister.

Step 4: Turn the black High Pressure Bypass Valve to ***CLEANING POSITION***. This procedure allows release of the high pressure air trapped within the system. Verify the gray Cleaning Valve is positioned to ***CLEANING***.

Step 5: Switch ***ON*** the breaker at main breaker panel to power up unit.

Step 6: Start the Low Pressure Boost Pump by pressing the ***LP PUMP*** pushbutton located on the Master Control Center (or on the Remote Control Center).

Step 7: Start the High Pressure Pump by pressing the ***HP PUMP*** pushbutton located on the Master Control Center panel (or on the Remote Control Center). Verify the Vacuum Pressure Gauge reads more than zero (0 psi), if not more than 0 psi recheck the valve positions from Step #1 or perform another Freshwater Flush to release any remaining trapped air in the system.

Step 8: Allow the RO unit to run for at least 15 minutes to circulate the winterizing solution into the membranes, hoses, fittings, and pumps.

Step 9: Shut off the unit. Unit can be left in standby mode for up to 6 months.

The freeze protection solution is now circulated throughout the feed and reject sides, including the membrane and the pumps. To protect the product side, open the blue hoses and drain out the water from the membrane outlets, the product solenoid valve, the product manifold, the product flowmeter, and product relief valve, if equipped.

Step 10: Then switch ***OFF*** at your breaker at the main breaker panel.

TO FLUSH WINTERIZATION SOLUTION FROM THE RO UNIT

To return your machine to operating condition after freeze protecting it, adhere to the following steps.

Step 1: Turn ***ON*** your water pressure and watermaker breakers on main electrical panel. Turn the High Pressure Bypass Valve to ***CLEANING*** (ensuring zero pressure in system). Verify the gray Cleaning Valve is positioned to ***NORMAL/REVERSE OSMOSIS*** position.

Step 2: Open the micron filter housing(s) and put new 20 and 5 micron filters (depending on RO model) inside. Fill the prefilter housing(s) with non-chlorinated freshwater.

Step 3: Verify the raw water intake to the RO is open.

Step 4: Start the Low Pressure Boost Pump by pressing the ***LP PUMP*** pushbutton located on the Master Control Center panel of the electronic instrument panel.

Step 5: Start the High Pressure Pump by pressing the ***HP PUMP*** pushbutton located on the Master Control Center panel of the electronic instrument panel.

Step 6: Flush unit with raw seawater for 20 minutes.

Step 7: After raw water flushing the unit for 20 minutes, shut down the ***HP PUMP*** and ***LP PUMP*** respectively.

Step 8: Turn ***OFF*** the breaker at the main breaker panel.

Step 9: To restart the **SQUIRT, SQUIRT MODULAR, or STOWAWAY**, refer to instructions in **Section 4.1: TO START THE SQUIRT (SPW/MPW) AND STOWAWAY (STW) UNITS.**

ALTERNATIVE FREEZE PROTECTION METHOD

Instead of applying propylene glycol to the RO system, an alternative method to freeze protect the RO is available.

Step 1: Perform a Chemical #3 preservation to the unit. To preserve the **STW, MPW or STW,** refer to instructions in **Section 5.6: STEPS FOR PRESERVATION CHEMICAL #3**

Step 2: Remove membrane vessels from the boat, placing caps over the fittings. This is a more practical alternative for the **Squirt MODULAR** system.

REMINDER: **Membranes must be kept wet with preservative solution.**

Step 3: Store the membranes in an environment protected from freezing.

Step 4: Refresh the preservative every 6 months as recommended.

Step 5: Drain the entire RO of all water.

8.0 TROUBLESHOOTING

This section is designed to guide the operator of the Village Marine Tec™ Squirt, Squirt Modular, or Stowaway unit in locating the probable cause of the most frequently encountered problems. This section can only be a guide to solving potential problems with the RO unit and cannot contain all possible malfunctions, nor can it contain all possible ways to determine the cause of a malfunction. The best troubleshooting tool is the knowledge of the plant gained through experience. Any condition not covered in this section may be resolved by contacting any Village Marine Tec™ Service Department.

Preliminary procedures:

1. Check for proper valve configuration for each of the operation modes selected.

2. Always check for loose connections or broken wires when checking electrical parts. Checking for continuity and solid contact can prevent hours of wasted effort.

3. Always inspect and test equipment or apparatus for probable cause of malfunction before performing replacement.

When using the troubleshooting guide on the following pages read all the probable causes before taking any action. Use good common sense and then use the probable cause that most likely fits the given situation.

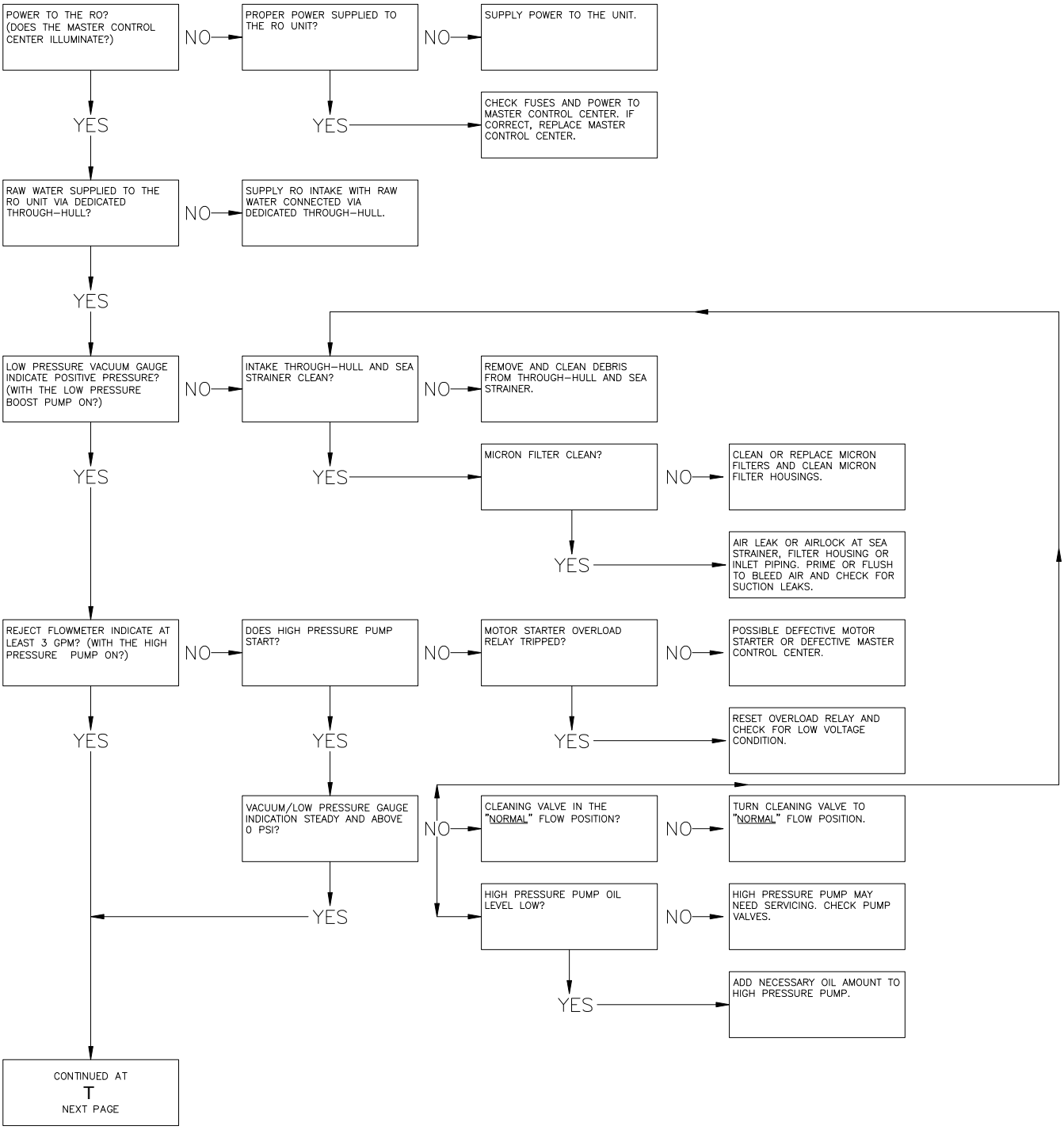

POWER TO THE RO? (DOES THE MASTER CONTROL CENTER ILLUMINATE?)
NO
PROPER POWER SUPPLIED TO THE RO UNIT?
NO
SUPPLY POWER TO THE UNIT.
YES
YES
CHECK FUSES AND POWER TO MASTER CONTROL CENTER. IF CORRECT, REPLACE MASTER CONTROL CENTER.
RAW WATER SUPPLIED TO THE RO UNIT VIA DEDICATED THROUGH–HULL?
NO
SUPPLY RO INTAKE WITH RAW WATER CONNECTED VIA DEDICATED THROUGH–HULL.
YES
LOW PRESSURE VACUUM GAUGE INDICATE POSITIVE PRESSURE? (WITH THE LOW PRESSURE BOOST PUMP ON?)
NO
INTAKE THROUGH–HULL AND SEA STRAINER CLEAN?
NO
REMOVE AND CLEAN DEBRIS FROM THROUGH–HULL AND SEA STRAINER.
YES
YES
MICRON FILTER CLEAN?
NO
CLEAN OR REPLACE MICRON FILTERS AND CLEAN MICRON FILTER HOUSINGS.
YES
AIR LEAK OR AIRLOCK AT SEA STRAINER, FILTER HOUSING OR INLET PIPING. PRIME OR FLUSH TO BLEED AIR AND CHECK FOR SUCTION LEAKS.
REJECT FLOWMETER INDICATE AT LEAST 3 GPM? (WITH THE HIGH PRESSURE PUMP ON?)
NO
DOES HIGH PRESSURE PUMP START?
NO
MOTOR STARTER OVERLOAD RELAY TRIPPED?
NO
POSSIBLE DEFECTIVE MOTOR STARTER OR DEFECTIVE MASTER CONTROL CENTER.
YES
YES
YES
RESET OVERLOAD RELAY AND CHECK FOR LOW VOLTAGE CONDITION.
VACUUM/LOW PRESSURE GAUGE INDICATION STEADY AND ABOVE 0 PSI?
NO
CLEANING VALVE IN THE "NORMAL" FLOW POSITION?
NO
TURN CLEANING VALVE TO "NORMAL" FLOW POSITION.
YES
HIGH PRESSURE PUMP OIL LEVEL LOW?
NO
HIGH PRESSURE PUMP MAY NEED SERVICING. CHECK PUMP VALVES.
YES
ADD NECESSARY OIL AMOUNT TO HIGH PRESSURE PUMP.
CONTINUED AT
T
NEXT PAGE

Table 7.1: Troubleshooting Flow Diagram

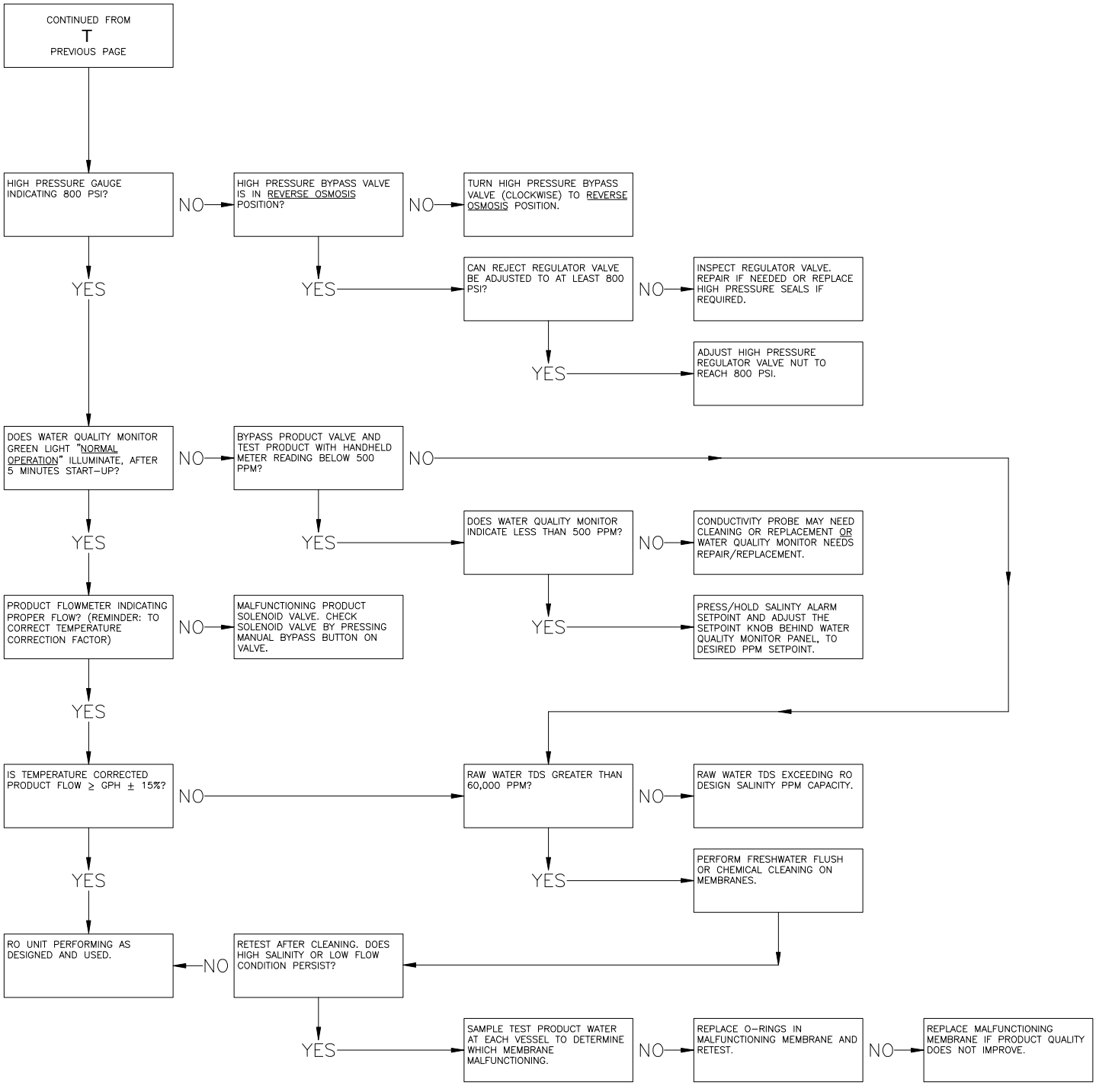
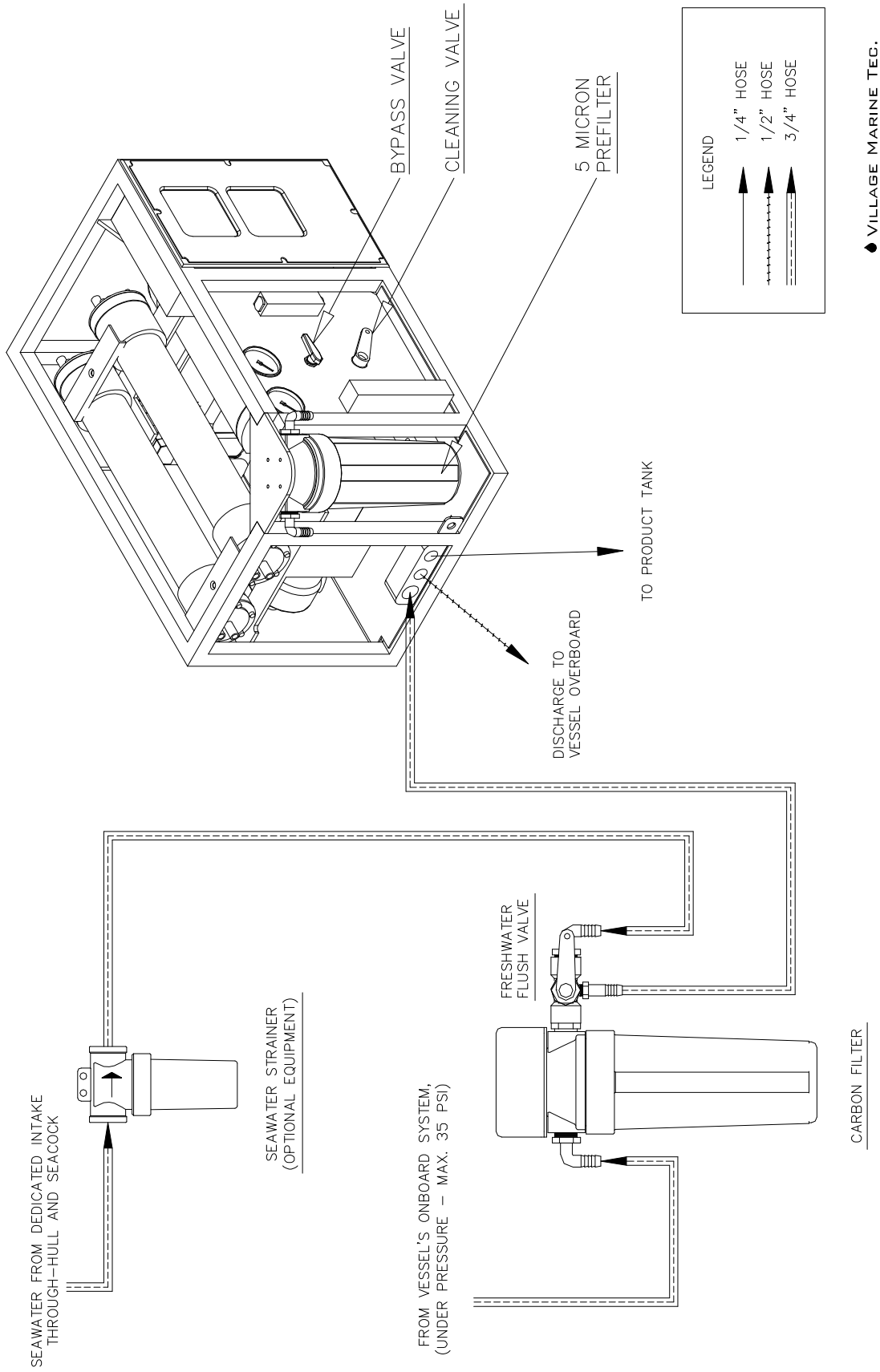

CONTINUED FROM T PREVIOUS PAGE
HIGH PRESSURE GAUGE INDICATING 800 PSI?
NO
HIGH PRESSURE BYPASS VALVE IS IN REVERSE OSMOSIS POSITION?
NO
TURN HIGH PRESSURE BYPASS VALVE (CLOCKWISE) TO REVERSE OSMOSIS POSITION.
YES
YES
CAN REJECT REGULATOR VALVE BE ADJUSTED TO AT LEAST 800 PSI?
NO
INSPECT REGULATOR VALVE. REPAIR IF NEEDED OR REPLACE HIGH PRESSURE SEALS IF REQUIRED.
YES
ADJUST HIGH PRESSURE REGULATOR VALVE NUT TO REACH 800 PSI.
DOES WATER QUALITY MONITOR GREEN LIGHT "NORMAL OPERATION" ILLUMINATE, AFTER 5 MINUTES START-UP?
NO
BYPASS PRODUCT VALVE AND TEST PRODUCT WITH HANDHELD METER READING BELOW 500 PPM?
NO
YES
YES
DOES WATER QUALITY MONITOR INDICATE LESS THAN 500 PPM?
NO
CONDUCTIVITY PROBE MAY NEED CLEANING OR REPLACEMENT OR WATER QUALITY MONITOR NEEDS REPAIR/REPLACEMENT.
PRODUCT FLOWMETER INDICATING PROPER FLOW? (REMINDER: TO CORRECT TEMPERATURE CORRECTION FACTOR)
NO
MALFUNCTIONING PRODUCT SOLENOID VALVE. CHECK SOLENOID VALVE BY PRESSING MANUAL BYPASS BUTTON ON VALVE.
YES
PRESS/HOLD SALINTY ALARM SETPOINT AND ADJUST THE SETPOINT KNOB BEHIND WATER QUALITY MONITOR PANEL, TO DESIRED PPM SETPOINT.
YES
IS TEMPERATURE CORRECTED PRODUCT FLOW ≥ GPH ± 15%?
NO
RAW WATER TDS GREATER THAN 60,000 PPM?
NO
RAW WATER TDS EXCEEDING RO DESIGN SALINITY PPM CAPACITY.
YES
YES
PERFORM FRESHWATER FLUSH OR CHEMICAL CLEANING ON MEMBRANES.
RO UNIT PERFORMING AS DESIGNED AND USED.
NO
RETEST AFTER CLEANING. DOES HIGH SALINITY OR LOW FLOW CONDITION PERSIST?
YES
SAMPLE TEST PRODUCT WATER AT EACH VESSEL TO DETERMINE WHICH MEMBRANE MALFUNCTIONING.
NO
REPLACE O-RINGS IN MALFUNCTIONING MEMBRANE AND RETEST.
NO
REPLACE MALFUNCTIONING MEMBRANE IF PRODUCT QUALITY DOES NOT IMPROVE.

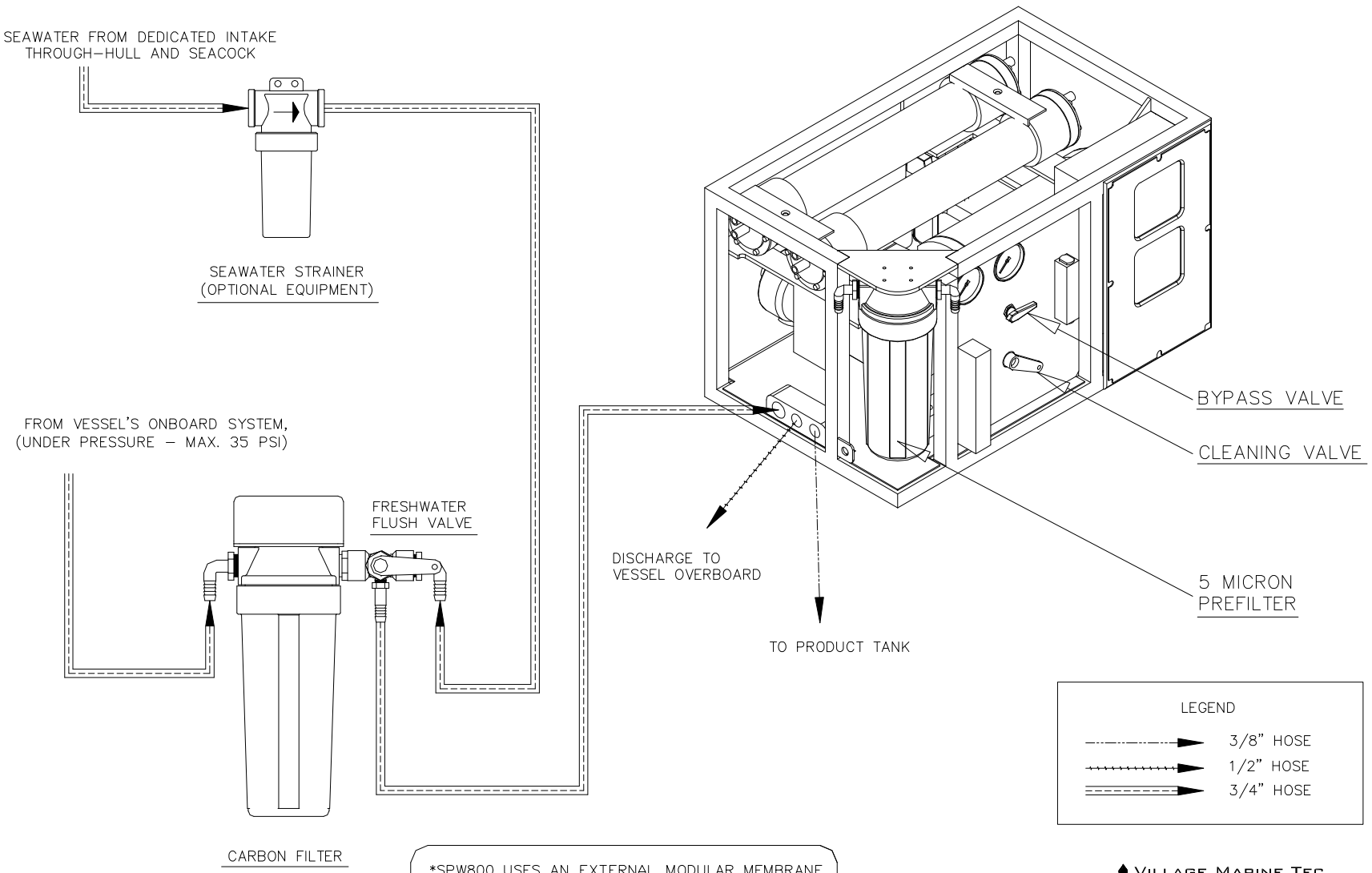
Table 7.2: Troubleshooting Flow Diagram (CONTINUED)

9.0 PLUMBING DIAGRAMS

SQUIRT (SPW 200-400)
PLUMBING DIAGRAM



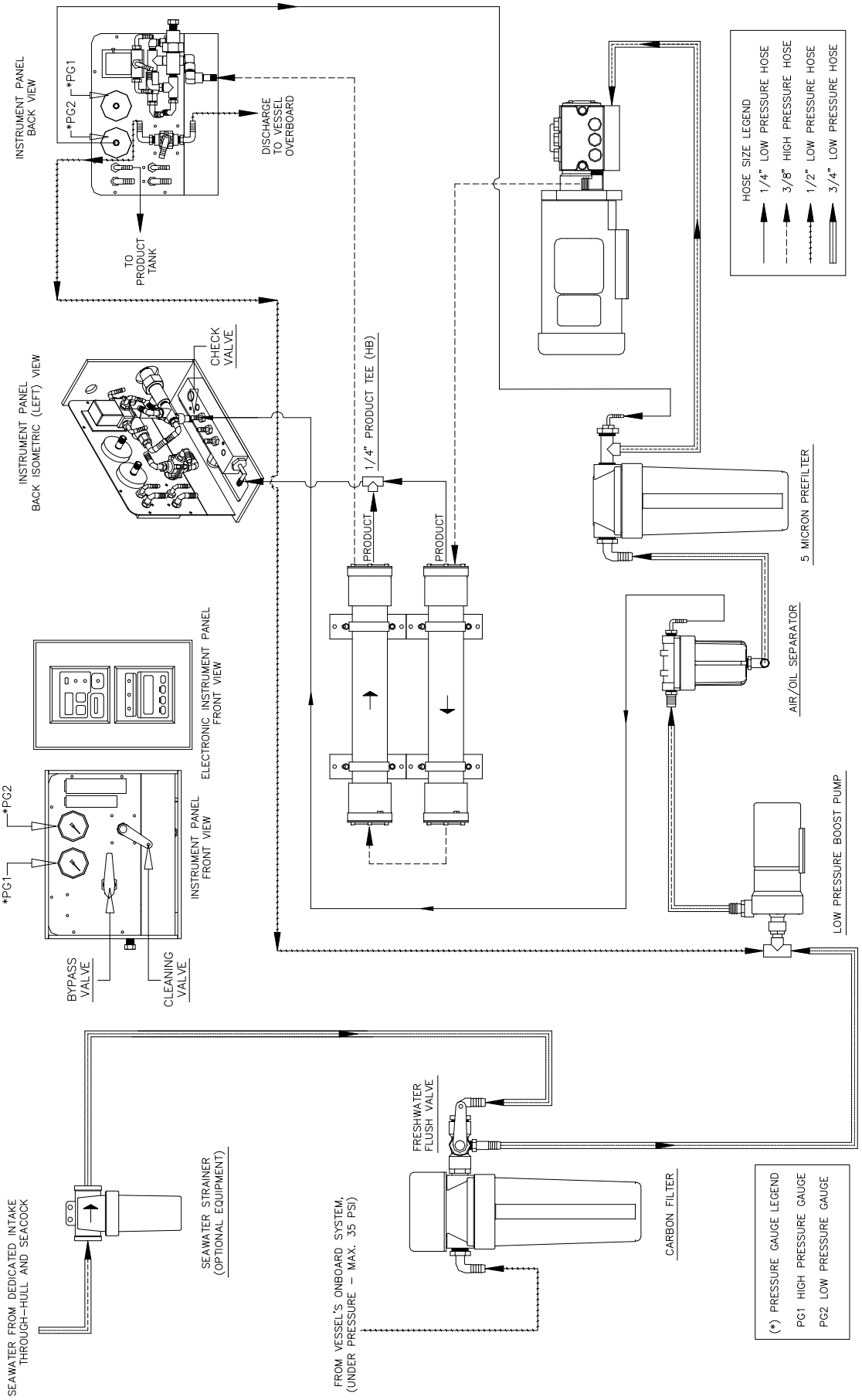
SQUIRT (SPW 600-800*)
PLUMBING DIAGRAM



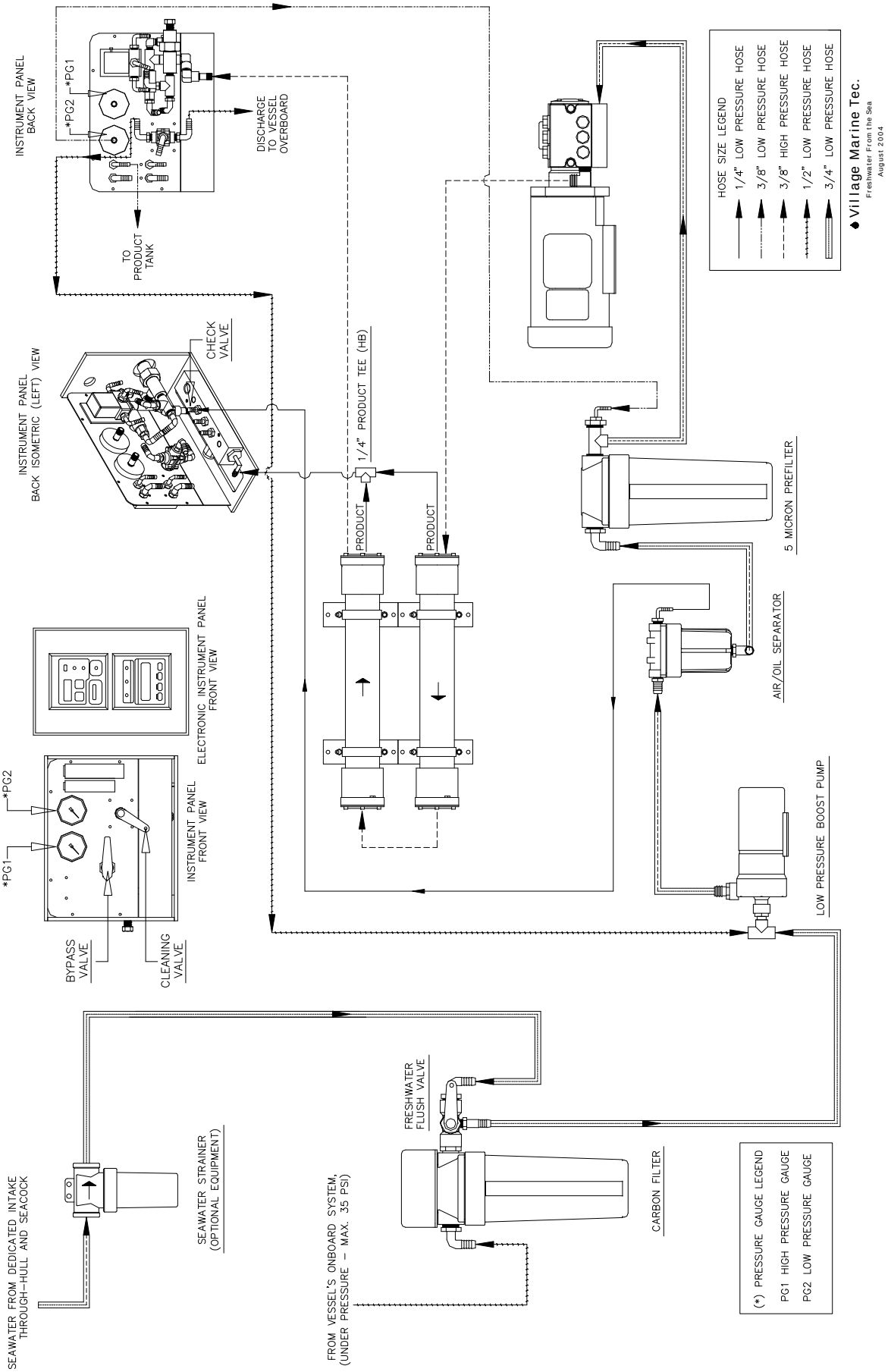
*SPW800 USES AN EXTERNAL MODULAR MEMBRANE RACK CONNECTED TO THE MAIN FRAME BY HOSES.

Village Marine Tec.
Freshwater From the Sea
November 2004

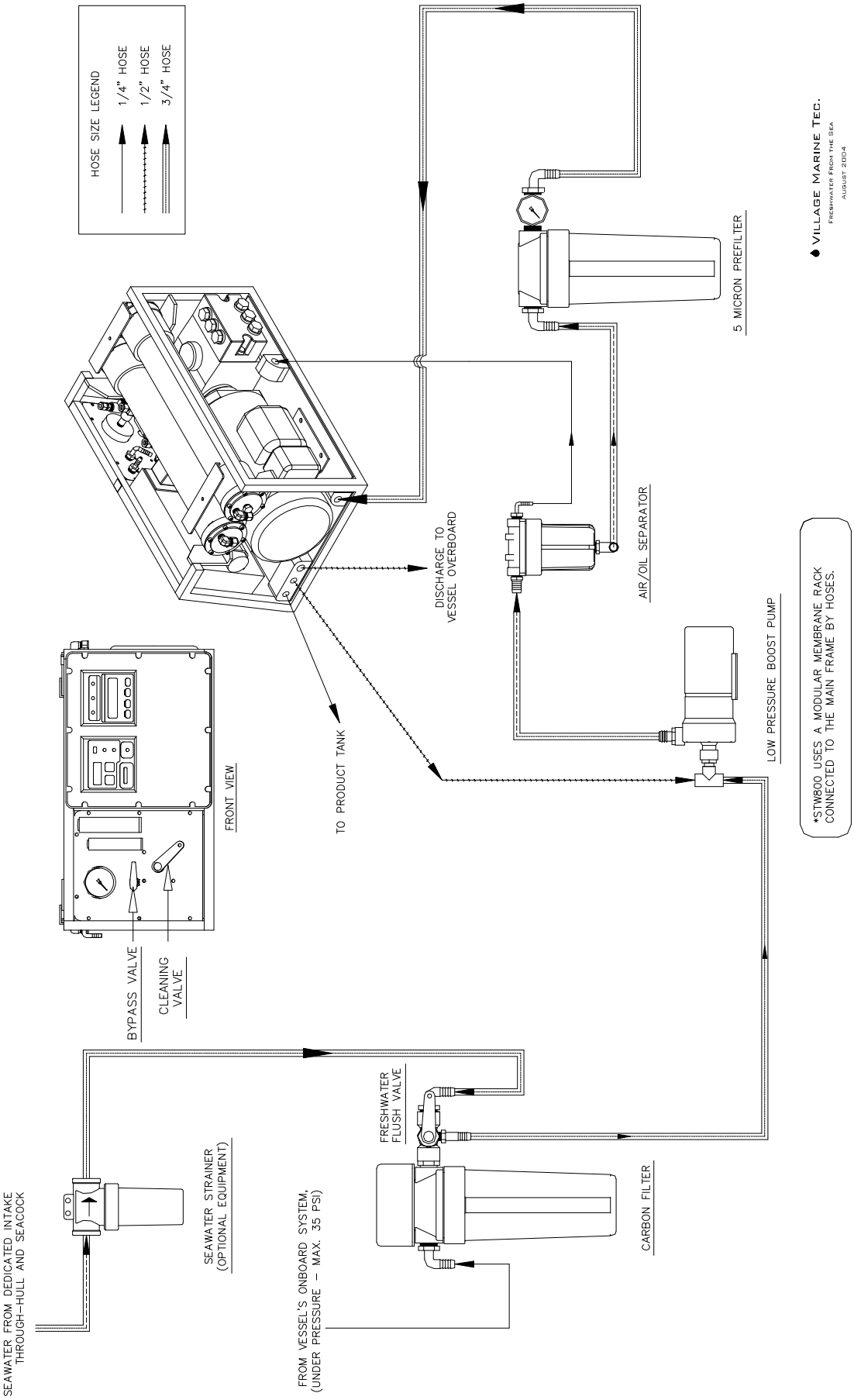
Squirt Modular (MPW) 200-400
Plumbing Diagram



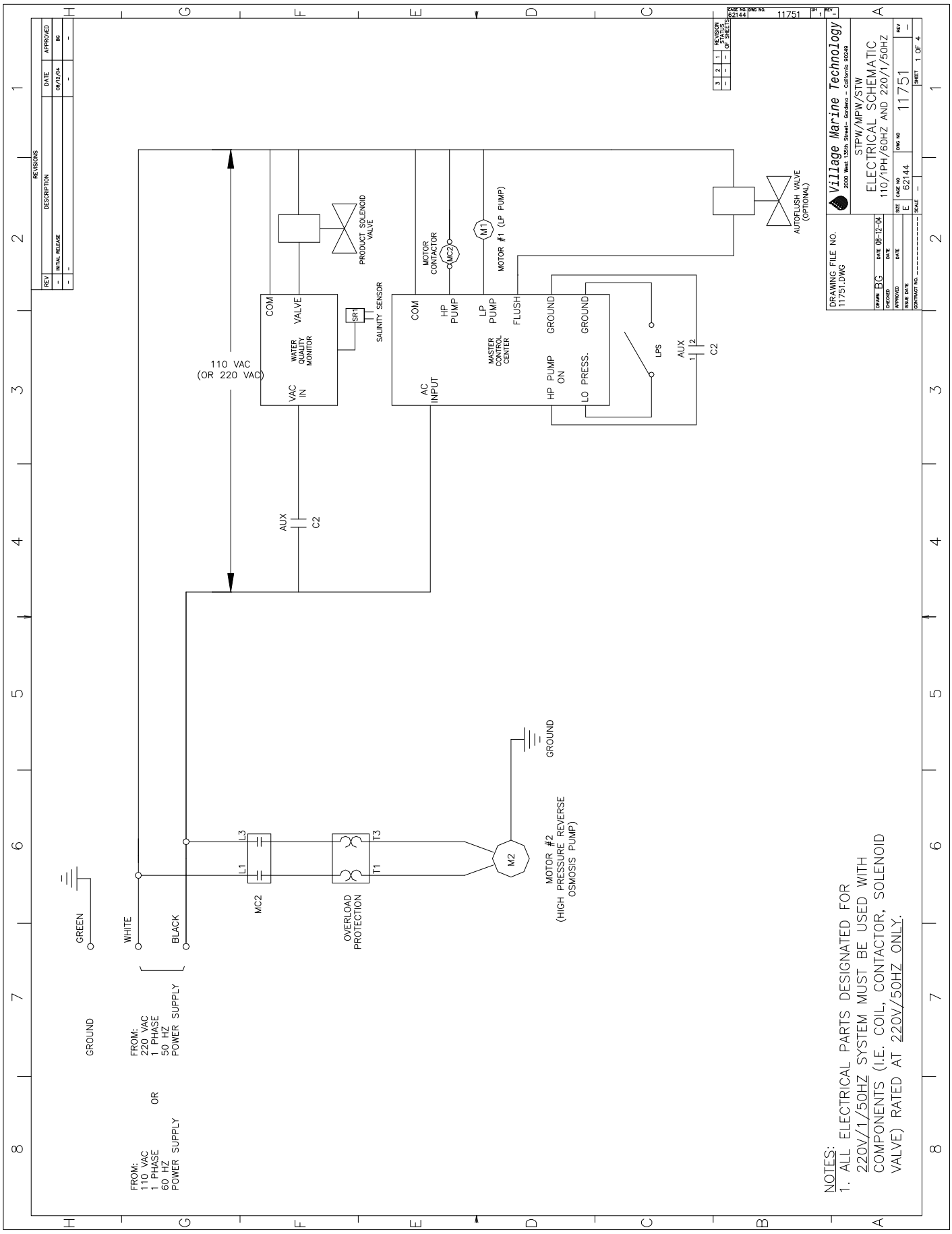
Squirt Modular (MPW) 600-800
Plumbing Diagram

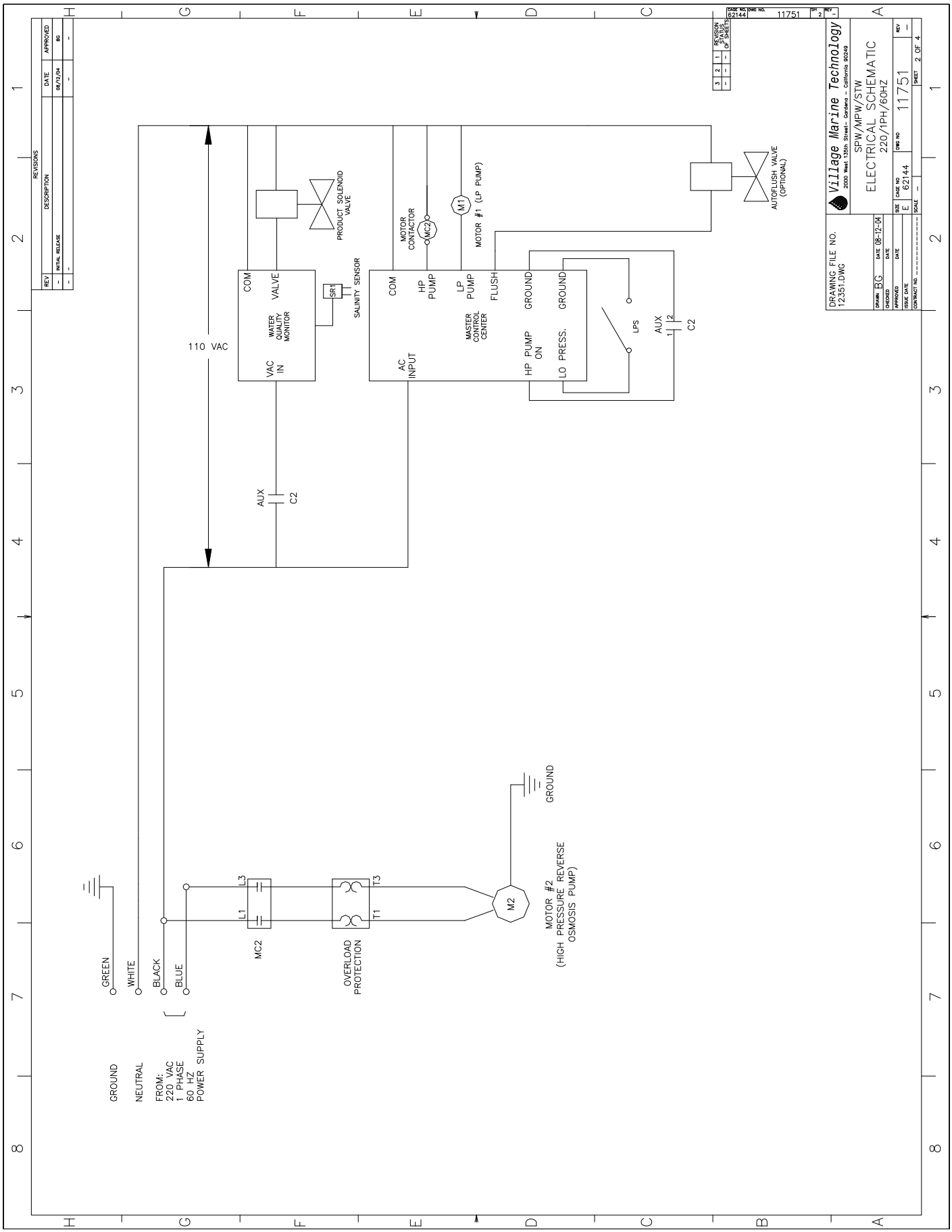


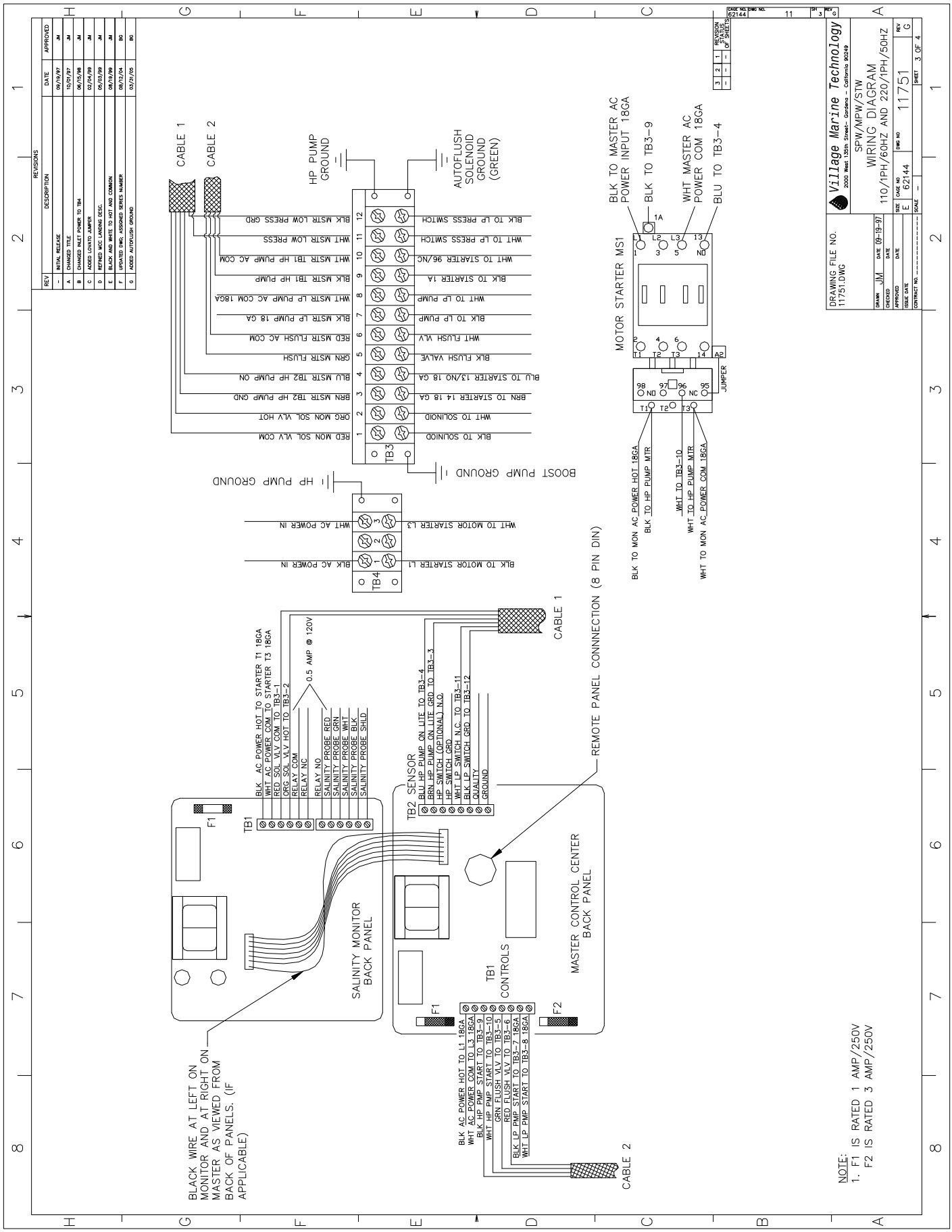
STOWAWAY SERIES (STW 200-800*)
PLUMBING DIAGRAM

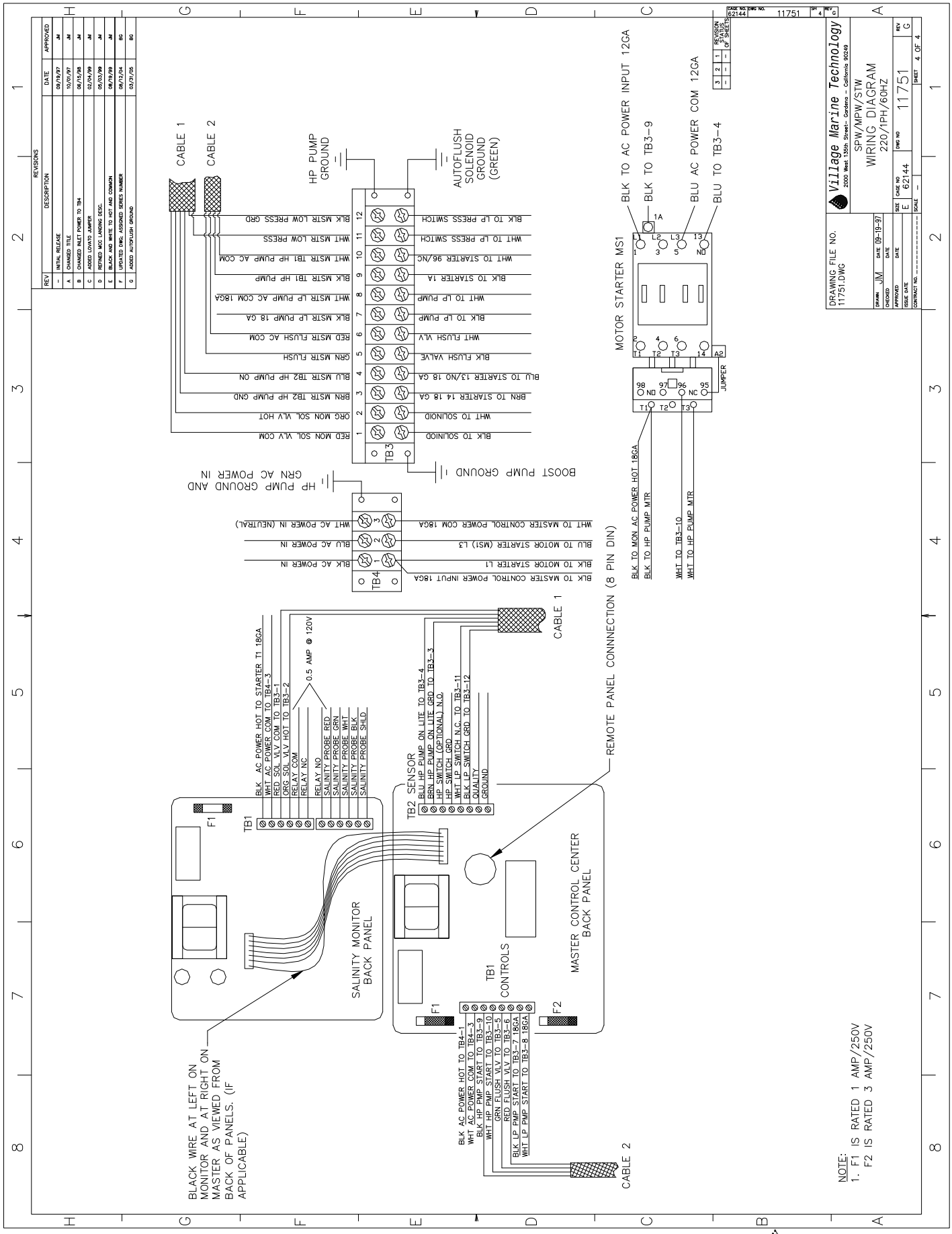


10.0 DIAGRAMS AND DRAWINGS


REVISIONS
REV
DESCRIPTION
DATE
APPROVED
- INITIAL RELEASE 09/12/04 BG
Village Marine Technology
2000 West 135th Street- Gardena - California 90249
STPW/MPW/STW
ELECTRICAL SCHEMATIC
110/1PH/60HZ AND 220/1/50HZ
DRAWING FILE NO. 11751.DWG
DRAWN BG DATE 09-12-04
CHECKED
APPROVED
ISSUE DATE
CONTRACT NO.
SIZE E
CAGE NO 62144
DWG NO 11751
REV -
SCALE -
SHEET 1 OF 4
110 VAC
(OR 220 VAC)
COM
VALVE
WATER QUALITY MONITOR
VAC IN
SR1
SALINITY SENSOR
PRODUCT SOLENOID VALVE
AUX
C2
MOTOR CONTACTOR
MC2
M1
MOTOR #1 (LP PUMP)
AUTOFLUSH VALVE (OPTIONAL)
MASTER CONTROL CENTER
AC INPUT
HP PUMP
LP PUMP
FLUSH
GROUND
HP PUMP ON
LO PRESS.
LPS
AUX
C2
GREEN
GROUND
WHITE
BLACK
FROM:
220 VAC
1 PHASE
50 HZ
POWER SUPPLY
OR
FROM:
110 VAC
1 PHASE
60 HZ
POWER SUPPLY
L3
L1
MC2
T3
T1
OVERLOAD PROTECTION
M2
MOTOR #2
(HIGH PRESSURE REVERSE OSMOSIS PUMP)
GROUND
NOTES:
1. ALL ELECTRICAL PARTS DESIGNATED FOR 220V/1/50HZ SYSTEM MUST BE USED WITH COMPONENTS (I.E. COIL, CONTACTOR, SOLENOID VALVE) RATED AT 220V/50HZ ONLY.

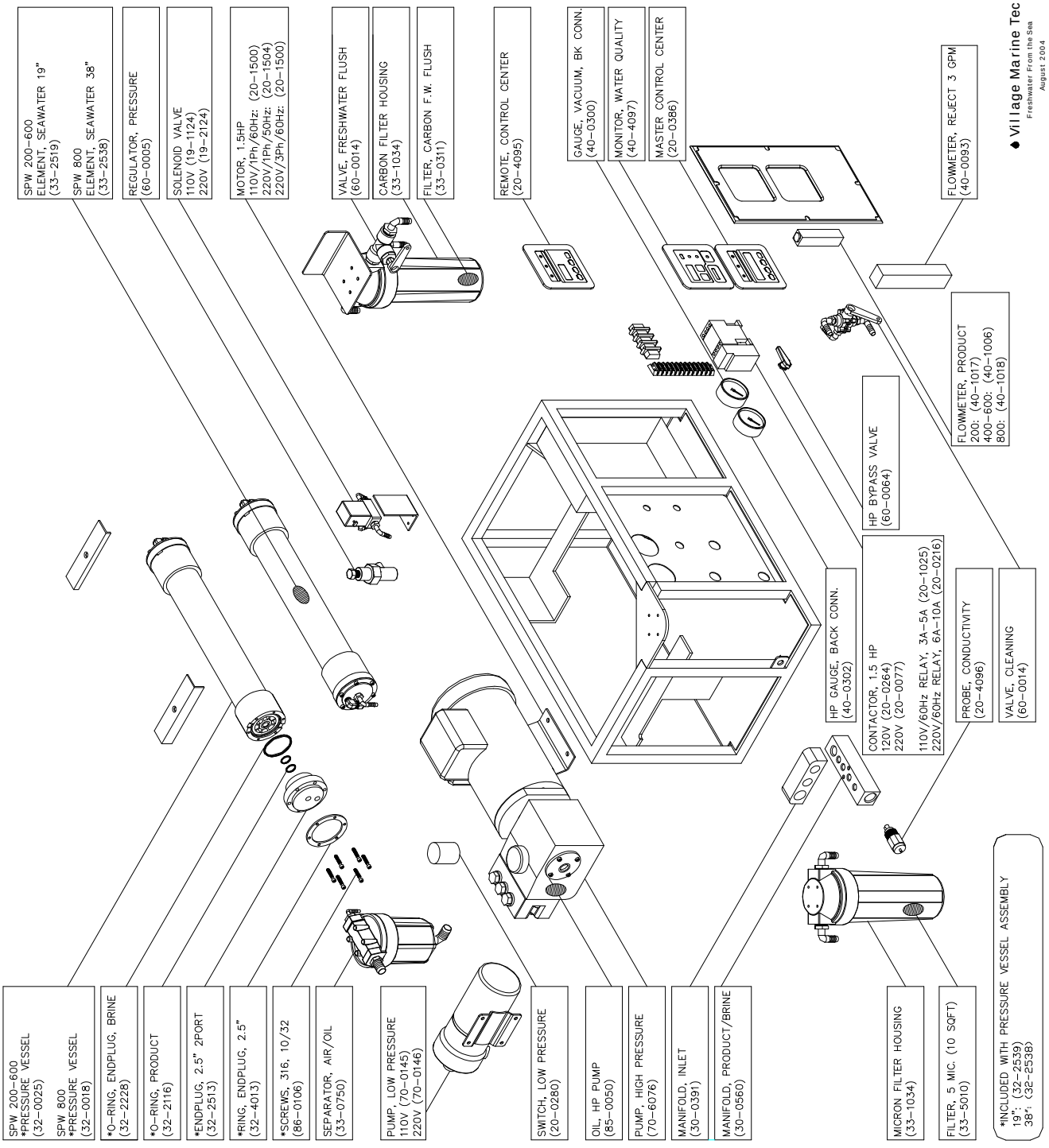

Village Marine Technology
2000 West 135th Street - Gardena - California 90249
SPW/MPW/STW
ELECTRICAL SCHEMATIC
220/1PH/60HZ
11751
DRAWING FILE NO. 12351.DWG
110 VAC
WATER QUALITY MONITOR
VAC IN
COM
VALVE
SR1
SALINITY SENSOR
PRODUCT SOLENOID VALVE
AUTOFLUSH VALVE (OPTIONAL)
MOTOR CONTACTOR
MC2
M1
MOTOR #1 (LP PUMP)
MASTER CONTROL CENTER
AC INPUT
HP PUMP
LP PUMP
FLUSH
GROUND
HP PUMP ON
LO PRESS.
LPS
AUX
C2
GREEN
WHITE
BLACK
BLUE
GROUND
NEUTRAL
FROM: 220 VAC 1 PHASE 60 HZ POWER SUPPLY
L1
L3
T1
T3
OVERLOAD PROTECTION
M2
MOTOR #2 (HIGH PRESSURE REVERSE OSMOSIS PUMP)


REVISIONS
REV DESCRIPTION DATE APPROVED
- INITIAL RELEASE 08/19/97 JM
A CHANGED TITLE 10/01/97 JM
B CHANGED INLET POWER TO TB4 06/15/98 JM
C ADDED LOVATO JUMPER 02/04/99 JM
D REFINED MCC LANDING DESC. 05/03/99 JM
E BLACK AND WHITE TO HOT AND COMMON 08/19/99 JM
F UPDATED DWG. ASSIGNED SERIES NUMBER 08/12/04 BG
G ADDED AUTOFLUSH GROUND 03/01/05 BG
CABLE 1
CABLE 2
HP PUMP GROUND
AUTOFLUSH SOLENOID GROUND (GREEN)
BLK MSTR LOW PRESS GRD
WHT MSTR LOW PRESS
WHT MSTR TB1 HP PUMP AC COM
BLK MSTR TB1 HP PUMP
WHT MSTR LP PUMP AC COM 18GA
BLK MSTR LP PUMP 18 GA
RED MSTR FLUSH AC COM
GRN MSTR FLUSH
BLU MSTR TB2 HP PUMP ON
BRN MSTR TB2 HP PUMP GND
ORG MON SOL VLV HOT
RED MON SOL VLV COM
BLK TO LP PRESS SWITCH
WHT TO LP PRESS SWITCH
WHT TO STARTER 96/NC
BLK TO STARTER 1A
WHT TO LP PUMP
BLK TO LP PUMP
WHT FLUSH VLV
BLK FLUSH VALVE
BLU TO STARTER 13/NO 18 GA
BRN TO STARTER 14 18 GA
WHT TO SOLENOID
BLK TO SOLENOID
TB3
BOOST PUMP GROUND
HP PUMP GROUND
WHT TO MOTOR STARTER L3
WHT AC POWER IN
BLK TO MOTOR STARTER L1
BLK AC POWER IN
TB4
BLK TO MASTER AC POWER INPUT 18GA
BLK TO TB3-9
WHT MASTER AC POWER COM 18GA
BLU TO TB3-4
MOTOR STARTER MS1
JUMPER
BLK TO MON AC_POWER HOT 18GA
BLK TO HP PUMP MTR
WHT TO TB3-10
WHT TO HP PUMP MTR
WHT TO MON AC_POWER COM 18GA
REMOTE PANEL CONNNECTION (8 PIN DIN)
CABLE 1
BLK AC POWER HOT TO STARTER T1 18GA
WHT AC POWER COM TO STARTER T3 18GA
RED SOL VLV COM TO TB3-1
ORG SOL VLV HOT TO TB3-2
RELAY COM
RELAY NC
RELAY NO
0.5 AMP @ 120V
SALINITY PROBE RED
SALINITY PROBE GRN
SALINITY PROBE WHT
SALINITY PROBE BLK
SALINITY PROBE SHLD
TB1
F1
TB2 SENSOR
BLU HP PUMP ON LITE TO TB3-4
BRN HP PUMP ON LITE GRD TO TB3-3
HP SWITCH (OPTIONAL) N.O.
HP SWITCH GRD
WHT LP SWITCH N.C. TO TB3-11
BLK LP SWITCH GRD TO TB3-12
QUALITY
GROUND
SALINITY MONITOR BACK PANEL
MASTER CONTROL CENTER BACK PANEL
TB1 CONTROLS
F1
F2
BLK AC POWER HOT TO L1 18GA
WHT AC POWER COM TO L3 18GA
BLK HP PMP START TO TB3-9
WHT HP PMP START TO TB3-10
GRN FLUSH VLV TO TB3-5
RED FLUSH VLV TO TB3-6
BLK LP PMP START TO TB3-7 18GA
WHT LP PMP START TO TB3-8 18GA
CABLE 2
BLACK WIRE AT LEFT ON MONITOR AND AT RIGHT ON MASTER AS VIEWED FROM BACK OF PANELS. (IF APPLICABLE)
NOTE:
1. F1 IS RATED 1 AMP/250V
F2 IS RATED 3 AMP/250V
DRAWING FILE NO. 11751.DWG
Village Marine Technology
2000 West 135th Street - Gardena - California 90249
SPW/MPW/STW
WIRING DIAGRAM
110/1PH/60HZ AND 220/1PH/50HZ
11751
DRAWN JM DATE 09-19-97
CHECKED
APPROVED
ISSUE DATE
CONTRACT NO.
SIZE E CAGE NO 62144 DWG NO 11751 REV G
SCALE -
SHEET 3 OF 4

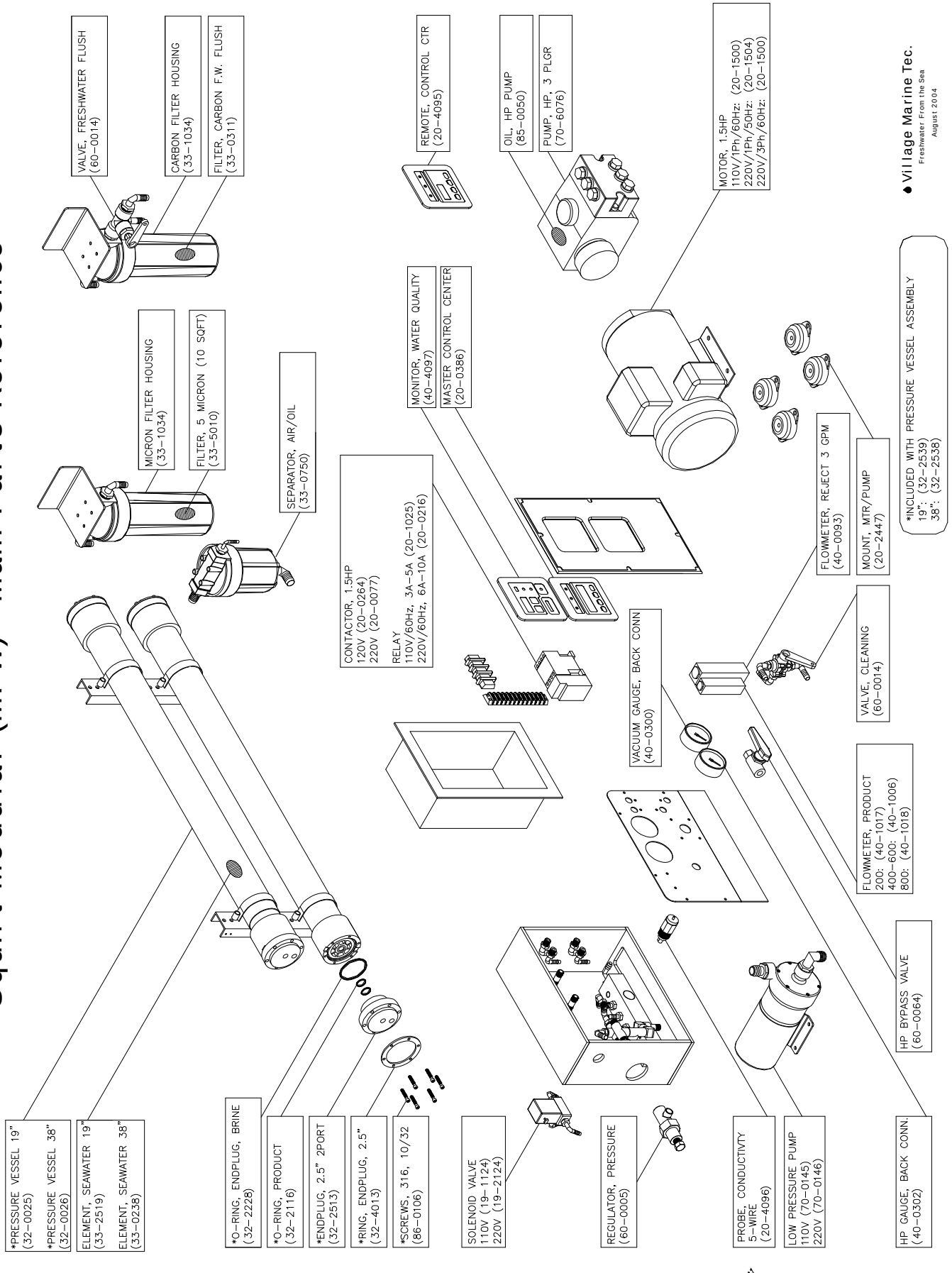

REVISIONS
REV | DESCRIPTION | DATE | APPROVED
- | INITIAL RELEASE | 09/19/97 | JM
A | CHANGED TITLE | 10/01/97 | JM
B | CHANGED INLET POWER TO TB4 | 08/15/98 | JM
C | ADDED LOVATO JUMPER | 02/04/99 | JM
D | REFINED MOC LANDING DESC. | 05/03/99 | JM
E | BLACK AND WHITE TO HOT AND COMMON | 08/19/99 | JM
F | UPDATED EMRL ASSIGNED SERIES NUMBER | 08/12/04 | BG
G | ADDED AUTOFLUSH GROUND | 03/31/05 | BG
CAGE NO. 62144 DWG NO. 11751 SH 4 REV G
REVISION STATUS OF SHEETS
Village Marine Technology
2000 West 135th Street- Gardena – California 90249
SPW/MPW/STW
WIRING DIAGRAM
220/1PH/60HZ
DRAWING FILE NO. 11751.DWG
DRAWN JM DATE 09-19-97
CHECKED DATE
APPROVED DATE
ISSUE DATE
CONTRACT NO. ----------
SIZE E CAGE NO 62144 DWG NO 11751 REV G
SCALE - SHEET 4 OF 4
CABLE 1
CABLE 2
HP PUMP GROUND
AUTOFLUSH SOLENOID GROUND (GREEN)
BLK TO SOLNOID
WHT TO SOLNOID
ORG MON SOL VLV HOT
RED MON SOL VLV COM
BRN TO STARTER 14 18 GA
BRN MSTR TB2 HP PUMP GND
BLU TO STARTER 13/NO 18 GA
BLU MSTR TB2 HP PUMP ON
BLK FLUSH VALVE
GRN MSTR FLUSH
WHT FLUSH VLV
RED MSTR FLUSH AC COM
BLK TO LP PUMP
BLK MSTR LP PUMP 18 GA
WHT TO LP PUMP
WHT MSTR LP PUMP AC COM 18GA
BLK TO STARTER 1A
BLK MSTR TB1 HP PUMP
WHT TO STARTER 96/NC
WHT MSTR TB1 HP PUMP AC COM
WHT TO LP PRESS SWITCH
WHT MSTR LOW PRESS
BLK TO LP PRESS SWITCH
BLK MSTR LOW PRESS GRD
TB3
BOOST PUMP GROUND
HP PUMP GROUND AND GRN AC POWER IN
BLK AC POWER IN
BLU AC POWER IN
WHT AC POWER IN (NEUTRAL)
BLK TO MASTER CONTROL POWER INPUT 18GA
BLK TO MOTOR STARTER L1
BLU TO MOTOR STARTER (MST) L3
WHT TO MASTER CONTROL POWER COM 18GA
TB4
MOTOR STARTER MS1
BLK TO AC POWER INPUT 12GA
BLK TO TB3-9
BLU AC POWER COM 12GA
BLU TO TB3-4
1A
JUMPER
BLK TO MON AC POWER HOT 18GA
BLK TO HP PUMP MTR
WHT TO TB3-10
WHT TO HP PUMP MTR
REMOTE PANEL CONNNECTION (8 PIN DIN)
BLK AC POWER HOT TO STARTER T1 18GA
WHT AC POWER COM TO TB4-3
RED SOL VLV COM TO TB3-1
ORG SOL VLV HOT TO TB3-2
RELAY COM
RELAY NC
RELAY NO
0.5 AMP @ 120V
SALINITY PROBE RED
SALINITY PROBE GRN
SALINITY PROBE WHT
SALINITY PROBE BLK
SALINITY PROBE SHLD
TB1
F1
SALINITY MONITOR BACK PANEL
TB2 SENSOR
BLU HP PUMP ON LITE TO TB3-4
BRN HP PUMP ON LITE GRD TO TB3-3
HP SWITCH (OPTIONAL) N.O.
HP SWITCH GRD
WHT LP SWITCH N.C. TO TB3-11
BLK LP SWITCH GRD TO TB3-12
QUALITY
GROUND
MASTER CONTROL CENTER BACK PANEL
TB1 CONTROLS
F1
F2
BLK AC POWER HOT TO TB4-1
WHT AC POWER COM TO TB4-3
BLK HP PMP START TO TB3-9
WHT HP PMP START TO TB3-10
GRN FLUSH VLV TO TB3-5
RED FLUSH VLV TO TB3-6
BLK LP PMP START TO TB3-7 18GA
WHT LP PMP START TO TB3-8 18GA
BLACK WIRE AT LEFT ON MONITOR AND AT RIGHT ON MASTER AS VIEWED FROM BACK OF PANELS. (IF APPLICABLE)
NOTE:
1. F1 IS RATED 1 AMP/250V
F2 IS RATED 3 AMP/250V

11.0 PARTS REFERENCE

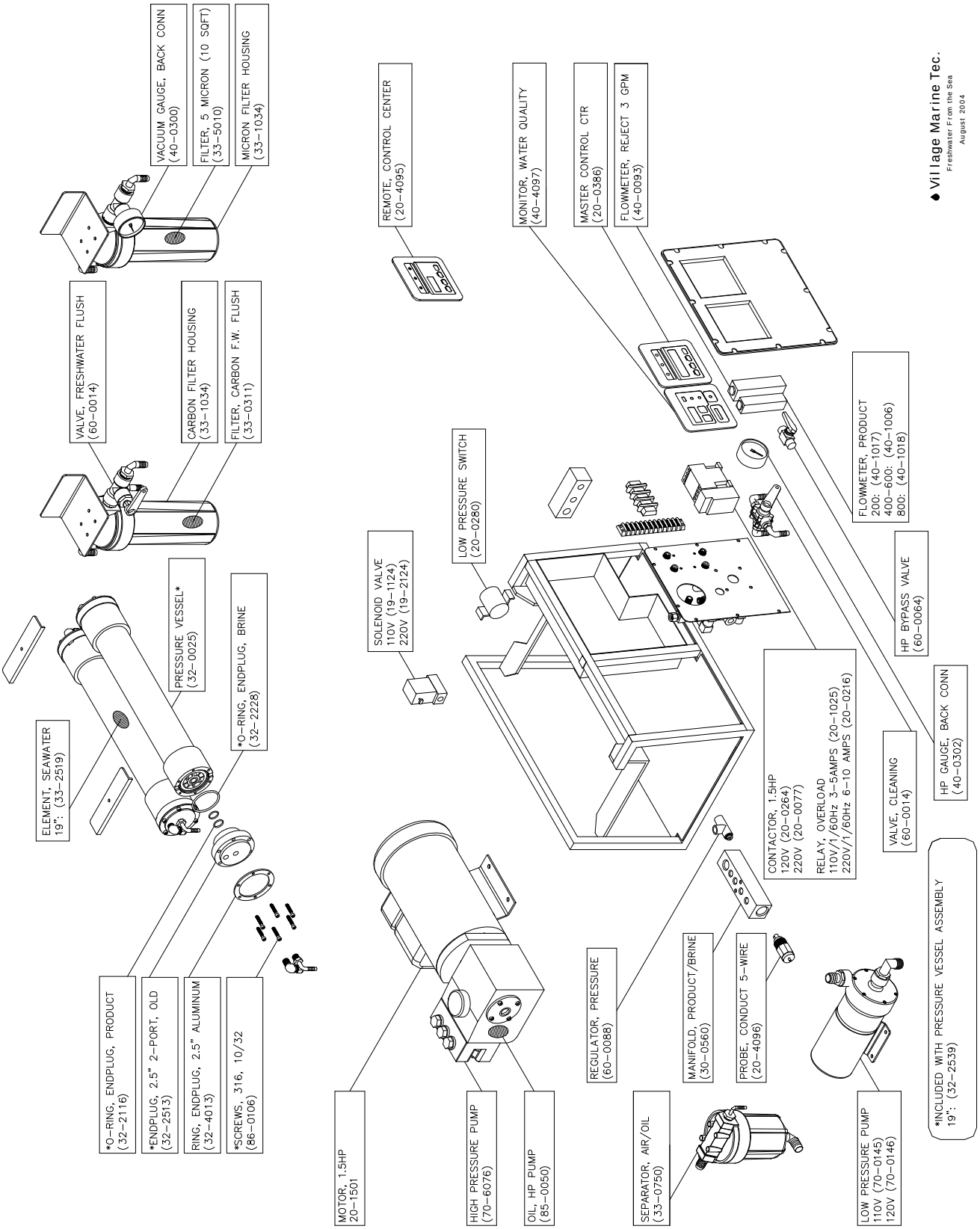
Squirt (SPW) - Main Parts Reference



Squirt Modular (MPW) - Main Parts Reference



Stowaway (SIW) - Main Parts Reference


VACUUM GAUGE, BACK CONN (40-0300)
FILTER, 5 MICRON (10 SQFT) (33-5010)
MICRON FILTER HOUSING (33-1034)
VALVE, FRESHWATER FLUSH (60-0014)
CARBON FILTER HOUSING (33-1034)
FILTER, CARBON F.W. FLUSH (33-0311)
PRESSURE VESSEL* (32-0025)
*O-RING, ENDPLUG, BRINE (32-2228)
ELEMENT, SEAWATER 19": (33-2519)
*O-RING, ENDPLUG, PRODUCT (32-2116)
*ENDPLUG, 2.5" 2-PORT, OLD (32-2513)
RING, ENDPLUG, 2.5" ALUMINUM (32-4013)
*SCREWS, 316, 10/32 (86-0106)
REMOTE, CONTROL CENTER (20-4095)
MONITOR, WATER QUALITY (40-4097)
MASTER CONTROL CTR (20-0386)
FLOWMETER, REJECT 3 GPM (40-0093)
SOLENOID VALVE 110V (19-1124) 220V (19-2124)
LOW PRESSURE SWITCH (20-0280)
FLOWMETER, PRODUCT 200: (40-1017) 400-600: (40-1006) 800: (40-1018)
HP BYPASS VALVE (60-0064)
CONTACTOR, 1.5HP 120V (20-0264) 220V (20-0077)
RELAY, OVERLOAD 110V/1/60Hz 3-5AMPS (20-1025) 220V/1/60Hz 6-10 AMPS (20-0216)
VALVE, CLEANING (60-0014)
HP GAUGE, BACK CONN (40-0302)
*INCLUDED WITH PRESSURE VESSEL ASSEMBLY 19": (32-2539)
MOTOR, 1.5HP 20-1501
HIGH PRESSURE PUMP (70-6076)
OIL, HP PUMP (85-0050)
REGULATOR, PRESSURE (60-0088)
MANIFOLD, PRODUCT/BRINE (30-0560)
PROBE, CONDUCT 5-WIRE (20-4096)
SEPARATOR, AIR/OIL (33-0750)
LOW PRESSURE PUMP 110V (70-0145) 120V (70-0146)
Village Marine Tec.
Freshwater From the Sea
August 2004

12.0 MANUFACTURER'S LITERATURE